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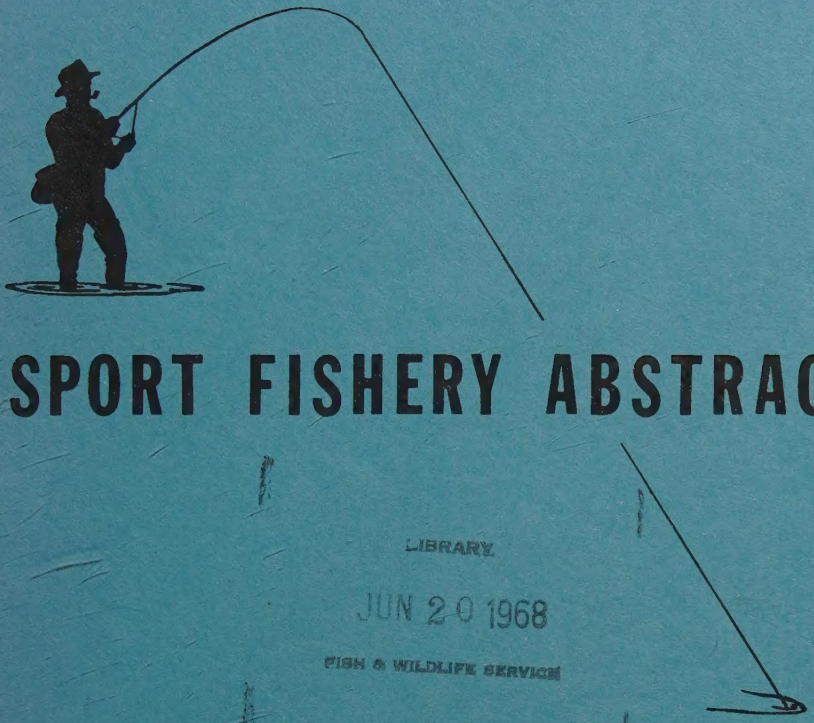

SPORT FISHERY ABSTRACTS

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SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Vol. 13, No. 1 Abstracts 9551-9761 1968

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

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Bureau of Sport Fisheries and Wildlife
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Washington, D. C. 20240

9551. Hergenrader, Gary L., and Arthur D. Hasler (Laboratory of Limnology, Univ. of Wisconsin, Madison, Wisc.). 1967. SEASONAL CHANGES IN SWIMMING RATES OF YELLOW PERCH IN LAKE MENDOTA AS MEASURED BY SONAR. Trans. Amer. Fish. Soc., 96(4): 373-382.

Sonar equipment was used during 1966 to study the relation between seasonally changing temperatures and swimming speeds of yellow perch, Perca flavescens (Mitchill), in Lake Mendota and the movements of the fish with respect to water currents in the lake. From its lowest point during winter (0-5° C) the rate of movement increased with increasing water temperatures until the maximum rate was reached during mid-summer when water temperatures were 20-25° C. As the lake cooled in autumn, the swimming speeds declined. The range of speeds in the frequency distribution during winter was less than that during summer when the distribution was spread out and encompassed a wide range of speeds. The swimming rate increased linearly with increasing temperature. The swimming speeds of individual perch were commonly only one-half those of schools at a given temperature interval suggesting that a "group effect" was correlated with the behavior of the perch schools. No consistent orientation of fishes to the currents in the lake was observed. The swimming direction of perch could not be correlated with the direction of the currents. (Authors)

9552. Cooper, Edwin L. (Pennsylvania State Univ., University Park, Penna.). 1967. GROWTH AND LONGEVITY OF BROOK TROUT (Salvelinus fontinalis) IN POPULATIONS SUBJECTED TO LIGHT EXPLOITATION. Trans. Amer. Fish. Soc., 96(4): 383-386.

Natural brook trout populations in two Pennsylvania streams which were exploited by angling only slightly were studied to determine the growth rate and longevity of this species. The growth rate of trout from the more fertile environment of Big Spring exceeded that of trout from Larry's Creek even though the standing crop of the population in Big Spring was markedly higher (206 pounds per acre in Big Spring; 39 pounds per acre in Larry's Creek). The longevity and age-composition of the two populations were similar, with few fish living as long as 6 years. Lee's phenomenon was not observed in either population. Since these populations were exploited only to a minor extent, such an observation is consistent with the hypothesis that selective angling mortality of the faster-growing individuals of a population is a reasonable explanation of Lee's phenomenon. (Auth.)

9553. Norden, Carroll R. (Univ. of Wisconsin-Milwaukee, Milwaukee, Wisc.). 1967. AGE, GROWTH AND FECUNDITY OF THE ALEWIFE, Alosa pseudoharengus (Wilson), IN LAKE MICHIGAN. Trans. Amer. Fish. Soc., 96(4): 387-393.

This study is based on over 2,000 specimens collected from the Milwaukee area of Lake Michigan over an 18-month period in 1964 and 1965. The ages of the fish, determined from their scales and otoliths, ranged from 1 to 4 years. The greatest growth-in-length, 55.7%, occurred during the first year of life. Growth-in-length in succeeding years declined to 24.5% in the second year, 11.2% in the third, and 8.6% in the fourth year of life. The body-scale relationship is a straight line with an intercept of 21.11 mm on the length axis. Calculated and imperical averages showed that Lake Michigan alewives attained a length of about 95 mm in their first year of life. They reached total lengths of about 139 mm (age group I), 158 mm (age group II), and 172 mm (age group III) in each of the following years. Spawning of Lake Michigan alewives in 1965 extended from the end of June to the first part of August, with the peak occurring in July. The majority of spawning alewives were in age groups II and III. Each female produced from 11,000 to 22,000 eggs. In the ripe alewife, the gonad made up about 5% of the total body weight in the males and about 10% in the females. (Auth.)

9554. Shetter, David S. (Michigan Dept. of Conservation, Lewiston, Mich.). 1967. EFFECTS OF JAW TAGS AND FIN EXCISION UPON THE GROWTH, SURVIVAL, AND EXPLOITATION OF HATCHERY RAINBOW TROUT FINGERLINGS IN MICHIGAN. Trans. Amer. Fish. Soc., 96(4): 394-399.

Approximately equal numbers (995 to 1,000) of jaw-tagged, fin-clipped, and

unmarked rainbow trout fingerlings were planted in experimental sections of Hunt Creek In October 1952. Observations on these fish during 1952-1957 provided data on the effects of marking on growth, survival, and angler exploitation. Jaw-tagged fish grew more slowly than did either the fin-clipped or unmarked fish; differences in growth increments were between 0.53 and 0.47 inch over an 11-month period. There was little difference in growth between fin-clipped and unmarked fish. Relatively few rainbow trout attempted to migrate, and no difference in extent of attempted migration was detected between marked and unmarked fish. There was no significant difference in angler exploitation rates among the three groups of fish in any one year, but the 5-year totals for the three groups showed highly significant differences. Tagged, fin-clipped, and normal rainbow trout were caught in increasing numbers, in that order. More tagged fish than control fish were lost to causes other than fishing, and fin-clipped fish were intermediate in this regard. The superimposition of 3,000 rainbow trout fingerlings on the Hunt Creek brook trout population in 1.75 miles of stream did not noticeably affect either the brook trout population or the brook trout angling during the 5 years involved. (Auth.)

9555. Dawson, C. E. (Gulf Coast Research Laboratory, Ocean Springs, Miss.). 1967. THREE NEW RECORDS OF PARTIAL ALBINISM IN AMERICAN HETEROSOMATA. Trans. Amer. Fish. Soc., 96(4): 400-404.

Three instances of partial albinism associated with one or more additional anomalies are described for the flatfish species Paralichthys lethostigma and Pseudopleuronectes americanus. An osteological abnormality in an albinistic Trinectes maculatus is noted and some possible causes of partial albinism in heterosomates are discussed. (Auth.)

9556. Radtke, Larry D., and Jerry L. Turner (Delta Fish and Wildlife Study, California Dept. of Fish and Game, Stockton, Calif.). 1967. HIGH CONCENTRATIONS OF TOTAL DISSOLVED SOLIDS BLOCK SPAWNING MIGRATION OF STRIPED BASS, Roccus saxatilis, IN THE SAN JOAQUIN RIVER, CALIFORNIA. Trans. Amer. Fish. Soc., 96(4): 405-407.

9557. Smith, Allen J. (U.S. Bureau of Commercial Fisheries, Hammond Bay Biological Station, Millersburg, Mich.). 1967. THE EFFECT OF THE LAMPREY LARVICIDE, 3-TRIFLUOROMETHYL-4-NITROPHENOL, ON SELECTED AQUATIC INVERTEBRATES. Trans. Amer. Fish. Soc., 96(4): 410-413.

9558. Hiltibran, Robert C. (Aquatic Biology Section, Illinois Natural History Survey, Urbana, Ill.). 1967. EFFECTS OF SOME HERBICIDES ON FERTILIZED FISH EGGS AND FRY. Trans. Amer. Fish. Soc., 96(4): 414-416.

9559. Werner, Robert G. (Dept. of Zoology, Indiana Univ., Bloomington, Ind.). 1967. INTRALACUSTRINE MOVEMENTS OF BLUEGILL FRY IN CRANE LAKE, INDIANA. Trans. Amer. Fish. Soc., 96(4): 416-420.

9560. Schmittou, H. R. (Agriculture Experiment Station, Auburn Univ., Auburn, Ala.). 1967. SEX RATIOS OF BLUEGILL IN FOUR POPULATIONS. Trans. Amer. Fish. Soc., 96(4): 420-421.

9561. Monan, Gerald E., John R. Pugh, and Jim R. Smith (U.S. Bureau of Commercial Fisheries, Fish-Passage Research Program, Seattle, Wash.). 1967. EFFICIENCY OF A COMBINED ELECTRODE AND LOUVER ARRAY IN GUIDING JUVENILE STEELHEAD TROUT (Salmo gairdneri). Trans. Amer. Fish. Soc., 96(4): 422-423.

9562. Roberson, Kenneth (Fisheries Research Inst., College of Fisheries, Univ. of Washington, Seattle, Wash.). 1967. AN OCCURRENCE OF CHINOOK SALMON BEACH SPAWNING IN LAKE WASHINGTON. Trans. Amer. Fish. Soc., 96(4): 423-424.

9563. Thompson, Richard B., and Dennis F. Tufts (U.S. Bureau of Commercial Fisheries Biological Laboratory, Seattle, Wash.). 1967. PREDATION BY DOLLY VARDEN AND SQUAWFISH ON HATCHERY-REARED SOCKEYE SALMON IN LAKE WENATCHEE, WASHINGTON. Trans. Amer. Fish. Soc., 96(4): 425-427.

9564. Herting, Gerald E., and Arthur Witt, Jr. (Peace Corps, Cuerpo de Paz, Puno, Peru). 1967. THE ROLE OF PHYSICAL FITNESS OF FORAGE FISHES IN RELATION TO THEIR VULNERABILITY TO PREDATION BY BOWFIN (Amia calva). Trans. Amer. Fish. Soc., 96(4): 427-430.

9565. MacLeod, J. C. (Ontario Dept. of Lands and Forests, Research Branch, Maple, Ontario, Canada). 1967. A NEW APPARATUS FOR MEASURING MAXIMUM SWIMMING SPEEDS OF SMALL FISH. J. Fish. Res. Bd. Canada, 24(6): 1241-1252.

An apparatus and method were developed to obtain comparative measurements of maximum swimming speeds of small fish. The present method is considered useful in bioassays for measuring sublethal effects of pollutants. The fish swim in an open-topped oval channel with a circumference of 1.48 m. A variable speed 1/8-hp motor turns two paddle wheels and creates measured currents up to 30 m per minute. Fish are not required to swim at the same velocity as the water in the chamber. Rather, they swim in a current which is greater than their maximum swimming speed and which moves them backwards in the channel. The average maximum swimming speed for a group of four to six fish is calculated from the current velocity, circumference of the channel, and the number of laps lost during a specific time period. Tests with fathead minnows, Pimephales promelas, showed that different current velocities gave the same swimming speed as long as the current was greater than the swimming speed of the fish. A swimming period of 3 minutes gave consistent results. Largemouth bass fingerlings, Micropterus salmoides, which were conditioned by exposing them once daily to the standard test in the chamber, showed a marked increase in swimming ability after 3 days. Fed and unfed fish showed equal increases in performance and the conditioned fish developed a slightly higher active metabolism. (Auth.)

9566. Skidmore, J. F. (Dept. of Zoology, Australian National Univ., Canberra, Australia). 1967. OXYGEN UPTAKE BY ZEBRAFISH (Brachydanio rerio) OF DIFFERENT AGES IN RELATION TO ZINC SULPHATE RESISTANCE. J. Fish. Res. Bd. Canada, 24(6): 1253-1267.

The routine rate of oxygen uptake, of 12 groups of zebrafish aged 0 to 100 days, was measured in well-aerated water free of zinc. The relationship between the rate of oxygen uptake (X) and survival time (T) in four toxic solutions of zinc was

$$(T-T_s)\ (X-X_s) = K$$

throughout the life cycle, where T_s, X_s, and K were constants. T was also related to the dry weight of the fish (W) in fish aged 5 days or over.

$$(4720\ W^{-.14} - 1500)\ (T - 1.3) = K$$

9567. Qadri, S. U. (Dept. of Biology, Univ. of Ottawa, Ottawa, Ontario, Canada). 1967. MORPHOLOGICAL COMPARISONS OF THREE POPULATIONS OF THE LAKE CHAR, Cristivomer namaycush, FROM ONTARIO AND MANITOBA. J. Fish. Res. Bd. Canada, 24(6): 1407-1411.

During a study on subspeciation and postglacial distribution of the lake char, Cristivomer namaycush (Walbaum), some morphological and meristic differences were observed between the planktonivorous lake char from Ontario and the piscivorous lake char from Ontario and Manitoba. These differences are described.

9568. Ovchynnyk, Michael M. 1967. FRESHWATER FISHES OF ECUADOR AND PERSPECTIVE FOR DEVELOPMENT OF FISH CULTIVATION. Monograph Series, No. 1, Latin American Studies Center, Michigan State University, East Lansing. 44 p.

9569. McFadden, James T., Gaylord R. Alexander, and David S. Shetter (Inst. for Fisheries Research, Michigan Conservation Dept., Lewiston, Mich.). 1967. NUMERICAL CHANGES AND POPULATION REGULATION IN BROOK TROUT Salvelinus fontinalis. J. Fish. Res. Bd. Canada, 24(7): 1425-1459.

A brook trout population in a stable stream environment was studied for 14 years. Population estimates were made each September, the catch of fish by anglers was recorded, and collections of fish were made to determine sex ratio, age at sexual maturity, and fecundity. The sex ratio was close to 1:1 for all age-groups. Some male trout were sexually mature at the end of the first year of life, most were mature at the end of the second year, and all were mature at the end of the third. No females were mature at the end of their first year, most were mature at the end of the second, and all were mature at the end of the third year of life. The regression of egg content on total length of female trout was determined. On the average 132,000 eggs were produced annually by the population in the study area, from which 4,813 fish survived to the end of the first year; 1,966 to the end of the second; 356 to the third; 29 to the fourth; and 0.6 to the end of the fifth year. The growth rate of the fish varied little during the period of study. Annual egg production varied between 80,000 and 212,000; the number of age-group 0 fish between 2,809 and 6,703; age-group I fish between 1,589 and 2,653; age-group II between 175 and 685; age-group III between 13 and 68; and age-group IV fish between 0 and 2. During the 14 years of observation, survival of adult fish tended to increase, leading to larger numbers of spawners. The larger egg complements which resulted tended to experience lower survival, thus largely preventing substantial increases in population size. Positive serial correlations exist in some of the series of estimates of numbers and of survival. No biological explanation is advanced for these serial correlations. Life tables and age-specific fecundity rates were calculated for 11 successive cohorts of brook trout. New reproduction rates varied from 0.74 to 1.88, averaging 1.14. The l_x components were about three times as variable as the m_x components, indicating that changes in death rates rather than changes in birth rates have been the principal immediate cause of fluctuations in the population. The m_x values were not related to population density in any way that would tend to regulate population size. Survival from the 12th to the 24th month of life was directly density-dependent. The pattern of survival from the 24th to the 36th month of life suggested an inverse density-dependent relationship. (Authors)

9570. Javaid, M. Yaqub, and John M. Anderson (Dept. of Biology, Carleton Univ., Ottawa, Ontario, Canada). 1967. THERMAL ACCLIMATION AND TEMPERATURE SELECTION IN ATLANTIC SALMON, Salmo salar, AND RAINBOW TROUT, S. gairdneri. J. Fish. Res. Bd. Canada, 24(7): 1507-1513.

The selected temperature for Atlantic salmon and rainbow trout, as determined in a horizontal gradient, increases with acclimation temperature over the acclimation range 5-20° C for salmon and 10-20° C for trout. The final preferendum for salmon is about 17° C. The results for rainbow trout suggest that the type of gradient used, i.e. vertical or horizontal, has a marked influence on the experimentally determined relation between acclimation temperature and selected temperature. (Authors)

9571. Javaid, M. Yaqub, and John M. Anderson (Dept. of Biology, Carleton Univ., Ottawa, Ontario, Canada). 1967. INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS. J. Fish. Res. Bd. Canada. 24(7): 1515-1519.

Starvation-induced changes were observed in the selected temperature of some under-yearling salmonids. In Atlantic salmon an upwards shift occurred within 24-28 hours after cessation of feeding. In brook trout and rainbow trout a downwards shift occurred within 24 hours after cessation of feeding. Brook trout showed an initial overshoot. These changes were maintained more or less constantly throughout the starvation period which lasted from 15 to 22 days. In all cases the selected temperature had returned to its pre-starvation value within 24 hours after resumption of feeding. (Authors)

9572. May, A. W. (Fisheries Research Board of Canada, Biological Station, St. John's, Newfoundland, Canada). 1967. FECUNDITY OF ATLANTIC COD. J. Fish. Res. Bd. Canada, 24(7): 1531-1551.

Fecundity of Atlantic cod from the Newfoundland and Labrador area was investigated in relation to fish length, weight, and age. Variations in fecundity were best explained in terms of size, either length or weight. The fecundity-length relationship was adequately described by the simple allometry formula; fecundity-weight by an arithmetic straight line. Differences in fecundity from north to south are described and discussed in relation to descriptions from other areas. Substantial differences in fecundity of western and eastern Atlantic cod are noted. (Auth.)

9573. Withler, F. C., and R. M. Humphreys (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1967. DURATION OF FERTILITY OF OVA AND SPERM OF SOCKEYE (Oncorhynchus nerka) AND PINK (O. gorbuscha) SALMON. J. Fish. Res. Bd. Canada, 24(7): 1573-1578.

At 8-9° C, sockeye ova without added water maintained their initial fertility for 12 hours and a few were still fertile after 175 hours; sockeye milt maintained its initial fertility for 11 hours, and fertilized a few ova after 101 hours. Pink salmon ova maintained their initial fertility for 8 hours and some were still fertile at 129 hours; pink salmon milt maintained its initial fertility for 33 hours and fertilized 67% of the test ova at 57 hours, but none at 81 hours. Comparison of these results with those of tests at lower storage temperatures suggests that cooler storage would extend the period of high fertility. (Authors)

9574. Smith, L. S., and G. R. Bell (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1967. ANESTHETIC AND SURGICAL TECHNIQUES FOR PACIFIC SALMON. J. Fish. Res. Bd. Canada, 24(7): 1579-1588.

An operating table and associated anesthetizing system for salmonids are described in detail. Techniques for vascular and urinary cannulation and sampling are also described along with comments on the use of physiological salines and anticoagulants. Utilization of these techniques and apparatus can make fish as convenient and useful an experimental animal as the laboratory rat. (Authors)

9575. Buttkus, H. (Fisheries Research Board of Canada, Vancouver Laboratory, Vancouver, B. C., Canada). 1967. AMINO ACID COMPOSITION OF MYOSIN FROM TROUT MUSCLE. J. Fish. Res. Bd. Canada, 24(7): 1607-1612.

The amino acid composition of myosin from the white muscle of trout has been determined and was found to be closely similar to that of rabbit myosin. Thirteen of the amino acid residues were present in concentrations identical to those of rabbit myosin or agreed within less than 3%. Valine, glycine, and methionine were present in slightly greater proportions. The histidine and proline contents of trout myosin differed from rabbit myosin by three residues per 10^5 g of protein and represented the greatest difference on a percent basis. The possible significance of these differences is discussed in relation to the lower enzymatic activity and the lower thermal stability of trout myosin. The apparent specific volume of trout myosin calculated from the amino acid composition ($0.735 \frac{cm^3}{g}$) was identical to that obtained by density measurements. An apparent molecular weight calculated from the amino acid analyses was 500,027 $\pm$ 44. (Auth.)

9576. Nakano, T., and N. Tomlinson (Fisheries Research Board of Canada, Vancouver Laboratory, Vancouver, B. C., Canada). 1967. CATECHOLAMINE AND CARBOHYDRATE CONCENTRATIONS IN RAINBOW TROUT (Salmo gairdneri) IN RELATION TO PHYSICAL DISTURBANCE. J. Fish. Res. Bd. Canada, 24(8): 1701-1715.

In rainbow trout (Salmo gairdneri) blood plasma concentrations of adrenaline (AD) and noradrenaline (NAD), and liver and heart concentrations of AD increased in response to severe physical disturbance. Skeletal muscle and anterior kidney

concentrations of AD and NAD did not change detectably. Maximum plasma concentrations observed during disturbances of the fish were 0.20-0.36 μg AD and 0.05-0.09 μg NAD/ml. These plasma concentrations decreased relatively rapidly during the recovery of the fish. Plasma glucose concentrations increased in response to disturbance, the magnitude and duration of the hyperglycemia being greater in those fish with initially high liver glycogen reserves. Liver glycogen concentrations in those fish with initially high (ca. 7%) concentrations apparently decreased in response to disturbance and increased during recovery of the fish, but no change was detected in liver glycogen concentrations in fish in which they were initially low (ca. 2.5%). Heart and skeletal muscle glycogen concentrations decreased in response to disturbance and increased during recovery. In skeletal muscle, the concentration of adenosine 3',5'-phosphate and the proportion of phosphorylase in the α form increased in response to disturbance of the fish and decreased thereafter. (Authors)

9577. Brett, J.R. (Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C., Canada). 1967. SWIMMING PERFORMANCE OF SOCKEYE SALMON (Oncorhynchus nerka) IN RELATION TO FATIGUE TIME AND TEMPERATURE. J. Fish. Res. Bd. Canada, 24(8): 1731-1741.

Further studies on the swimming performance of fingerling sockeye salmon at fixed velocities have been conducted in relation to fatigue time. The method of probit analysis, commonly used in dealing with bioassay data, was found to be suitable for determining times to 50% fatigue and in providing a measure of variance despite the presence of some erratic behavior. For sockeye acclimated to 15° C (mean length = 13.6 cm) the velocity at which 50% fatigued was 54.4 cm/sec or 4.0 lengths/sec (L/sec). The 5% and 95% fatigue velocities were 3.1 and 4.8 L/sec, respectively. Larger fish required longer exposure times for determining maximum sustained speeds, extending from approximately 120 minutes for fingerlings to 500 minutes for adults. Using the method of increasing velocity steps the effect of temperatures from 5 to 27.5° C was examined. When acclimated to 15° C fingerling sockeye exhibited only a 4% reduction in swimming speed at 10 and 20°C. Temperatures above the lethal level caused a rapid decline in swimming ability approaching the extinction point at 27.5° C. Recommendations for standard procedures in the study of swimming speeds are made. (Auth.)

9578. Smith, M.W., and J.W. Saunders (Fisheries Research Board of Canada, Biological Station, St. Andrews, N.B., Canada). 1967. MOVEMENTS OF BROOK TROUT IN RELATION TO AN ARTIFICIAL POND ON A SMALL STREAM. J. Fish. Res. Bd. Canada, 24(8): 1743-1761.

A 20-year study showed that forming a pond near the mouth of Ellerslie Brook, Prince Edward Island, did not change the seasonal pattern of brook trout movements between fresh- and salt water. Delay in movements of trout through the pond and a tidal pool below the dam resulted in heavy natural and angling mortalities in those areas. Movements between fresh- and salt water were almost eliminated. Natural seeding of stream above pond was not demonstrably affected. (Authors)

9579. Smith, L.S., J.R. Brett, and J.C. Davis (Fisheries Research Institute, College of Fisheries, Univ. of Washington, Seattle, Wash.). 1967. CARDIOVASCULAR DYNAMICS IN SWIMMING ADULT SOCKEYE SALMON. J. Fish. Res. Bd. Canada, 24(8): 1775-1790.

Dorsal aortic blood pressure, heart rate, and oral water pressure were recorded in adult sockeye salmon (Oncorhynchus nerka) while they were resting in darkened aquaria or swimming in an illuminated tunnel-respirometer. Pressures were recorded on an oscillograph attached to pressure transducers connected with cannulae in the dorsal aorta and oral cavity. The velocity of the water in the swimming chamber was increased in stepwise fashion every 30 minutes until the fish stopped swimming and were swept against an electrified grid. At the cessation of swimming, which was considered as the onset of fatigue, water velocity was decreased to a minimum which permitted the fish to

rest and dorsal aortic blood pressure, heart rate, and oral water pressure were recorded for about 1 hour as they returned toward resting levels. Resting values were 44/38 mm Hg (systolic/diastolic) and 49 heartbeats/min. At maximal swimming speed dorsal aortic blood pressure was 55/49 mm Hg and heart rate was 83 beats/min. No abrupt changes in cardiovascular function occurred at the onset of fatigue. A number of morphological (length and weights of the body and ventricle) and cardiovascular (pressures, rates) variables were measured in six adult sockeye salmon. A significant correlation was found between hematocrit, ventricle weight, and heart rate; a change in one apparently caused adjustments in the other two in order to maintain a constant supply of oxygen to the tissues during subfatigue levels of activity. The effects of removal and replacement of blood or isotanic saline in the dorsal aorta were observed in three adult sockeye salmon. Removal of blood produced a proportionate decrease in blood pressure and an increase in heart rate. Neither dilution of the blood by replacement with saline nor increase in blood volume from addition of saline had any significant effect on heart rate and blood pressure.

9580. van Overbeeke, A. P., and J. R. McBride (Dept. of Biological Sciences, Simon Fraser Univ., Burnaby, B. C., Canada). 1967. THE PITUITARY GLAND OF THE SOCKEYE (Oncorhynchus nerka) DURING SEXUAL MATURATION AND SPAWNING. J. Fish. Res. Bd. Canada, 24(8): 1791-1810.

This communication presents the results of a study of the pituitaries of 150 sockeye salmon in various stages of sexual maturation from the time they entered freshwater till after completion of spawning. In the homologue of the adenohypophysis, nine different cell types were distinguished. On the basis of changes in tinctorial and histochemical properties and relative proportions of each of these cells, it was concluded that the sockeye pituitary contains six different hormone-producing cell types. One of these probably possesses a gonadotrophic function. Degenerative phenomena in the pituitary were found in the sexually ripe and the spent salmon, but only to a limited extent. The implications of the changes in the occurrence of the six different cell types and the degenerative alterations are discussed in relation to gonad development and the death after spawning. (Authors)

9581. Agris, Paul F. (Bucknell Univ., Lewisburg, Penn.). 1967. COMPARATIVE EFFECTS OF A LAMPRICIDE AND OF ANOXIA ON THE SEA LAMPREY. J. Fish. Res. Bd. Canada, 24(8): 1819-1822.

9582. Lauzier, L. M. (Fisheries Research Board of Canada, Biological Station, St. Andrews, N. B., Canada). 1967. BOTTOM RESIDUAL DRIFT ON THE CONTINENTAL SHELF AREA OF THE CANADIAN ATLANTIC COAST. J. Fish. Res. Bd. Canada, 24(9): 1845-1859.

From 1961 to 1965, 14,137 sea-bed drifters were released over the Continental Shelf from the Gulf of St. Lawrence to the Gulf of Maine–Bay of Fundy to investigate the residual drift along the bottom. A total of 2,772 drifters were recovered either from the sea floor or along the shores. The recovery pattern, in time and in space, is studied for various portions of the Shelf. The inferred residual bottom drift is shown in a series of three charts. The estimated rate of drift lies between 0.2 and 0.7 nautical mile/day. The continuity of bottom drift over large areas is indicated. The relationship of surface to bottom drift is studied. Areas of convergence and upwelling are emphasized. No seasonal variations in the direction of bottom drift and in the speed have as yet been detected. (Auth.)

9583. Kalff, Jacob (Dept. of Zoology, McGill Univ., Montreal, Quebec, Canada). 1967. PHYTOPLANKTON DYNAMICS IN AN ARCTIC LAKE. J. Fish. Res. Bd. Canada, 24(9): 1861-1871.

Primary production measurements (C^{14}) and phytoplankton counts were made in an arctic lake between June and September 1963. Annual carbon fixation was estimated at 8.5 g/m^2 (4.0 g/m^3), of which approximately 22% occurred under the ice. Phytoplankton numbers varied between 2.4 and 24.1 x 10^6 cells/liter. The proportion of small nannoplankton ($\leq 10\mu$) fluctuated between 51.0 and 100% and

averaged 84.5%. Few of the organisms were larger than 20 μ. The highest numbers of phytoplankton were found near the lake bottom when between 1.20 and 1.75 m of ice covered the lake. Some evidence is provided suggesting that the organisms near the bottom lived heterotrophically when the lake was ice-covered. Insufficient light rather than nutrient deficiencies appears to have limited autotrophic carbon fixation under the ice. (Auth.)

9584. Sandeman, I. M., and J. H. C. Pippy (Dept. of Biology, Memorial Univ. of Newfoundland, St. John's, Newfoundland, Canada). 1967. PARASITES OF FRESHWATER FISHES (SALMONIDAE AND COREGONIDAE) OF INSULAR NEWFOUNDLAND. J. Fish. Res. Bd. Canada, 24(9): 1911-1943.

A survey was made of the parasites of freshwater game fishes in Insular Newfoundland. A total of 304 fish from five species (Salvelinus fontinalis, Salmo salar (grilse, landlocked, parr, smolt), Salmo gairdneri, Salmo trutta, and Coregonus clupeaformis) was examined from 43 sampling stations covering the main watersheds of the island. Twenty-six parasitic species are recorded. Two new species, Phyllodistomum limnosa and Salmincola exsanguinata, are described. Descriptions are given and the systematic positions of the following discussed: Trichophrya piscium, Crepidostomum farionis, Apophallus brevis (metacercariae), Dibothriocephalus sp., Echinorhynchus lateralis, Metabronema salvelini, Philonema agubernaculum, Salmincola salmonea, and Argulus canadensis. A host-parasite list with percentage infections is given for all species of fish and a table showing the distribution between river and lake fish over the island as a whole is given for the commoner parasites of S. fontinalis. Distribution and host specificity are discussed. (Authors)

9585. Brocksen, Robert W., Gerald E. Davis, and Charles E. Warren (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oreg.). 1968. COMPETITION, FOOD CONSUMPTION, AND PRODUCTION OF SCULPINS AND TROUT IN LABORATORY STREAM COMMUNITIES. J. Wildlife Mgmt., 32(1): 51-75.

Intraspecific and interspecific competition for food were studied in simple communities in laboratory streams stocked with reticulate sculpins (Cottus perplexus), cutthroat trout (Salmo clarki), and carnivorous stoneflies of the genus Acroneuria. Herbivorous midge larvae were the principal prey organisms. Different combinations and densities of the carnivorous species were used in different streams and experiments. The rates of food consumption, respiration, and growth of sculpins and trout in the laboratory stream communities were found to be functions of prey density. Measurements of prey density thus may be useful measures of food availability for certain predators in some aquatic systems. Prey density in the streams was a function of predator density. These findings together suggest possible ways of modeling the production of a predator by using functions of the densities of the predator, its competitors, and its prey. Such models may make it possible to identify the seasonal or ecosystem changes that alter the relationships between the biomass and production of a predator and may be useful for predicting the biomass of a predator that would maximize its production. (Authors)

9586. Hanson, Arthur J., and Howard D. Smith (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1967. MATE SELECTION IN A POPULATION OF SOCKEYE SALMON (Oncorhynchus nerka) OF MIXED AGE-GROUPS. J. Fish. Res. Bd. Canada, 24(9): 1955-1977.

Anadromous Skeena River sockeye mature and spawn mainly at ages 4_2 and 5_2. Lesser numbers of 3_2, 5_3, and 6_3 and 6_4 fish, and non-anadromous kokanee, may spawn in the same stream. Mate selection by the different types was studied by observing salmon of known length and using the relationship found between length and age in dead, spawned fish. Fish of all lengths tended to mate with similar sized fish. Small males were less successful in holding mates than were large males because they could not successfully defend redds against larger intruders. Small males spent more time alone than large ones and frequently lay in groups behind mating pairs. The term "satellite male" is used in describing the behavior. Small females mated with large males but spent more time alone than did large females. The genetic implications of mating within age-groups are considered. (Authors)

9587. McCormick, J. Michael, R. Michael Laurs, and James E. McCauley (Dept. of Oceanography, Oregon State Univ., Corvallis, Oreg.). 1967. A HYDROID EPIZOIC ON MYCTOPHID FISHES. J. Fish. Res. Bd. Canada, 24(9): 1985-1989.

9588. Mather, Frank J., III, Martin R. Bartlett, and James S. Beckett (Woods Hole Oceanographic Institution, Woods Hole, Mass.). 1967. TRANSATLANTIC MIGRATIONS OF YOUNG BLUEFIN TUNA. J. Fish. Res. Bd. Canada, 24(9): 1991-1997.

9589. McCart, P., and B. Andersen (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1967. PLASTICITY OF GILL-RAKER NUMBER AND LENGTH IN Oncorhynchus nerka. J. Fish. Res. Bd. Canada, 24(9): 1999-2002.

9590. McCleave, James D. (Dept. of Zoology and Entomology, Montana State Univ., Bozeman, Mont.). 1967. HOMING AND ORIENTATION OF CUTTHROAT TROUT (Salmo clarki) IN YELLOWSTONE LAKE, WITH SPECIAL REFERENCE TO OLFACTION AND VISION. J. Fish. Res. Bd. Canada, 24(10): 2011-2044.

In-season homing was exhibited by mature cutthroat trout (Salmo clarki) displaced from spawning tributaries to Yellowstone Lake during late May to early August 1964, 1965, and 1966. Of 1,908 trout tagged and displaced from Clear and Cub creeks to three release points in the lake (1.55-7.95 km) and to the mouths of the streams, 614 (32.2%) homed, 119 (6.2%) strayed, and 28 (1.5%) were captured by anglers. Only slight differences in homing performance from various release points occurred, but there were differences among years and between streams. Adjusted mean homing times from the various release points ranged from 16 hours to 155 hours, with an inverse relation between homing times and the distance to the release point apparent in one year. Blockage of the olfactory or visual sense did not affect the percent of trout homing or straying. However, visual clues did increase the speed of homing, since homing times for blinded trout were much longer than for olfactory-occluded, control (anesthetized only), or non-anesthetized trout. A compass-type orientation occurred which was apparently not in response to visual or olfactory stimuli. A general east-northeastward (Clear and Pelican Creek trout) or northward (Cub Creek trout) orientation was exhibited by blind, anosmic, control, and non-anesthetized trout that were float-tracked from an open-water point. Blind and anosmic trout oriented as well as control trout. The directions of orientation were not in the directions of the home-streams, and orientation was not at a constant angle to the current directions or the sun azimuths. (Auth.)

9591. Narver, David W. (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1967. PRIMARY PRODUCTIVITY IN THE BABINE LAKE SYSTEM, BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 24(10): 2045-2052.

Primary productivity in Babine Lake, British Columbia, as measured by the C^{14} in situ method in 1966 was slightly lower in the North Arm (outlet) and Morrison Arm (an inlet) than in the main lake region. An unusually high rate of photosynthesis at one part of the main lake in September may have been related to the decomposition of salmon carcasses in a nearby stream. Morrison Lake, a major tributary, was much lower in rate of photosynthesis, pH, alkalinity, compensation depth, and total dissolved solids than any part of Babine Lake. The rate of carbon fixation of Babine Lake was much less on a per unit area basis than those reported by other workers for the majority of 24 sockeye salmon lakes in southwestern Alaska but was similar to most per unit volume of the euphotic layer. Much of this difference is attributable to a shallower euphotic zone in Babine Lake. Ranked with the 24 Alaskan lakes, Babine was first in alkalinity, third in TDS, and fifth in pH. The productivity measurements suggest that the carrying capacity for sockeye salmon per unit of nursery area of the main lake region is at least as great as that of the North Arm. (Auth.)

9592. Beers, J.R., and G. L. Stewart (Inst. of Marine Resources, Univ. of California, San Diego, La Jolla, Calif.). 1967. MICRO-ZOOPLANKTON IN THE EUPHOTIC ZONE AT FIVE LOCATIONS ACROSS THE CALIFORNIA CURRENT. J. Fish. Res. Bd. Canada, 24(10): 2053-2068.

Quantitative samples of the plankton which passed 202-μ mesh filter cloth were collected with a pumping system at five locations from the slope waters of the Pacific Ocean off San Diego to across the California Current. A general decrease in the numbers of micro-zooplankton, averaged over the depth of the euphotic zone, was found from the slope waters (310,000/m^3, Station I) to the site farthest offshore (99,000/m^3, Station V). At the various sites Protozoa accounted for between 59% and 83% of the total numbers, but only 18-23% of the total micro-zooplankton volume. The calculated volumes of the micro-zooplankton ranged from 22.9 mm^3/m^3 (Station I) down to 6.3 mm^3/m^3 (Station V). (Authors)

9593. Hartman, W. L., W. R. Heard, and B. Drucker (Bureau of Commercial Fisheries Biological Laboratory, Auke Bay, Alaska). 1967. MIGRATORY BEHAVIOR OF SOCKEYE SALMON FRY AND SMOLTS. J. Fish. Res. Bd. Canada, 24(10): 2069-2099.

Considerable new data on the characteristics of sockeye fry and smolt migrations, direct underwater observations of migrating smolts, and a review of the literature are presented here with a synthesis, evaluation, and interpretation of possible survival advantages of these phenomena. Most fry migrations from spawning areas to nursery lakes take place in the spring, when harsh winter conditions in lakes are moderating and the growing season is beginning. Smolt migrations to salt water closely follow spring breakup of the ice and warming of the lake water. The time of smolt migration is correlated closely with latitude: migration is earlier in southern streams than in northern streams. The duration of seasonal migration appears to be strongly related to travel distance to the trunk river outlet. The smolt exodus is rapid and regular in single-lake systems but irregular and extended in multilake or multibasin systems. The frequency distribution of smolts migrating from two-lake or two-basin systems is usually bimodal. Most migrations commence as water temperatures near 40° F and are over when temperatures approach 50° F. Migrations of smolts and especially fry are mainly confined to the darkest hours of the night. In general, in any one season, the oldest and the largest smolts in each age-group migrate first. Other factors, such as the thickness of the ice, effectiveness of solar radiation in melting ice and warming water, and daily weather (including sunlight and wind), also influence seasonal and diel migration patterns. Underwater observations of smolts at night during migration show that they are schooled, travel in the upper water levels in shallow rivers and deeper (but not near the bottom) in deeper rivers, and usually face downstream and swim as they migrate. During migrations, fry and smolts are both often subjected to a depensatory mortality from intense predation by birds and fish. A factor disproportionately affecting different smolt populations is the length and number of restricted passages along the route to the ocean. Smolts migrating in multilake systems must encounter heavier predation than smolts migrating from single-lake systems. Predation is probably minimized en route because of innate migratory behavior patterns. Exceptions to the general migratory behavior of fry and smolts are described to show the wide range in behavioral response to variable environmental situations. (Authors)

9594. Coble, Daniel W. (Ontario Dept. of Lands and Forests, Glenora Fisheries Station, Picton, Ontario, Canada). 1967. THE WHITE SUCKER POPULATION OF SOUTH BAY, LAKE HURON, AND EFFECTS OF THE SEA LAMPREY ON IT. J. Fish. Res. Bd. Canada, 24(10): 2117-2136.

Information on ecology and dynamics of white suckers, Catostomus commersoni (Lacépède), in South Bay, Lake Huron, was obtained from experimental fishing over more than a decade and from a tagging program in 1955 and 1956. (A total of 1,667 suckers were tagged and 8% of them were subsequently recovered.) The fish moved about extensively in the bay, minimal distance travelled averaging 3.8 km during a summer. Nevertheless, it was necessary to divide the bay into

discrete fishing areas for calculating population and mortality estimates. The length-weight relationship of adult suckers in June was $W = 5.883 \times 10^{-4} L^{2.92262}$, where W is weight in pounds and L is fork length in inches. Growth averaged only about 7.6 mm/year, and an annulus was not formed on the scales every year. In 1956 the population may have amounted to about 160,000 adult white suckers, or 23 fish per hectare or 17.5 kg/hectare, for the part of the bay less than 36 m deep. The exploitation rate appeared to be less than 2%. The annual survival rate of suckers larger than approximately 38 cm appeared to be about 70-75% decreasing with size of fish. Although it is not known if the size of the population has changed, the size composition changed between 1953 and 1964 through the loss of larger fish. Marked changes in the fauna of South Bay subsequent to the late 1940's include the invasion of the sea lamprey, Petromyzon marinus Linnaeus, and the alewife, Alosa pseudoharengus (Wilson), the disappearance of the lake trout, Salvelinus namaycush (Walbaum), and the decline of the population of the cisco, Coregonus (=Leucichthys) artedii LeSueur. The loss of the larger fish in the white sucker population was probably caused by the sea lamprey, for it occurred after the destruction of the lake trout population and corresponded with increased incidence of lamprey scarring of suckers. (Auth.)

9595. Thurston, Robert V. (Dept. of Zoology and Entomology, Montana State Univ., Bozeman, Mont.). 1967. ELECTROPHORETIC PATTERNS OF BLOOD SERUM PROTEINS FROM RAINBOW TROUT (Salmo gairdneri). J. Fish. Res. Bd. Canada, 24(10): 2169-2188.

Electrophoretic patterns on acrylamide gels of blood serum proteins from over 400 hatchery rainbow trout (Salmo gairdneri) subjected to different environmental stress have been examined. Stresses to which fish were subjected were: reduction of oxygen, addition of copper sulfate, addition of sodium sulfite, and different methods of capture. Comparisons of patterns were made on the basis of sex, degree of maturity, and location of blood extraction. Comparisons were also made with blood protein patterns of wild rainbow trout taken from a local stream. Patterns showed marked intraspecific differences, and revealed a characteristic band for sexually ripe females. Significant variations were found which were attributed to degree of maturity, method of sampling, repeated sampling of the same individual, and method of capture. No significance was attributed to variations related to reduction of environmental oxygen or the addition of sublethal levels of sodium sulfite. Significant pattern variations were noted with the addition of copper sulfate. Comparisons with wild rainbow trout showed significant pattern differences. (Auth.)

9596. Narver, David W. (Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C., Canada). 1967. PRIMARY PRODUCTION IN TWO SMALL LAKES OF THE NORTHERN INTERIOR PLATEAU OF BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 24(10): 2189-2193.

9597. Evelyn, T.P.T. (Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C., Canada). 1967. PIGMENTS FROM A SOCKEYE SALMON (Oncorhynchus nerka) WITH UNUSUAL SKIN COLOURATION. J. Fish. Res. Bd. Canada, 24(10): 2195-2199.

9598. Branham, Lowell. 1968. NEWEST FISH THAT SWIMS. Field and Stream, 72(10): 64-65, 155, 157, 159-160.

In 1965 male white bass were successfully crossed with female striped bass and some 35,000 fry were released during April in a pothole somewhat connected with Cherokee Lake, a 30,000-acre TVA impoundment. Some of these hybrids netted in the fall of 1965 were 8 and 9 inches long. The survival was at least 15 percent from spring to fall. The seined fish were released in the main lake. In the spring of 1966 they showed up with the white bass spawning run at the headwaters of the reservoir as 13-inch fish. By the fall of 1966 some 3-pound fish were taken. Two-year-old hybrids weighing from 3 to 5 pounds showed up in the white bass spawning run of 1967. With the success of white bass in many reservoirs and the rapid spread of landlocked striped bass to new waters, the future of this hybrid will be closely watched.

9599. Borgeson, David P., and George W. McCammon (Calif. Dept. Fish and Game, Sacramento, Calif.). 1967. WHITE CATFISH (Ictalurus catus) OF THE SACRAMENTO-SAN JOAQUIN DELTA. Calif. Fish and Game, 53(4): 254-263.

The biology and vital statistics of white catfish in the Sacramento-San Joaquin Delta were investigated during the period 1952-55. Amphipods (Corophium spp.) were the most important food of catfish in the lower Delta. The seventh vertebra was used to determine age. Growth was calculated from the vertebral - fish length relationship $L = 0.76760 + 0.056651R - 0.000051R^2$. Mean fork lengths at each year of life were: Age I - 3.1 inches; Age II - 5.2 inches; Age III - 6.9 inches; Age IV - 8.4 inches; Age V - 9.9 inches; Age VI - 11.5 inches; Age VII - 12.9 inches; Age VIII - 13.8 inches. Spawning commenced when water temperatures reached 70° F in June and continued into July. About 50% of fish in the 6.5- to 7.4-inch group were mature. Almost all fish over 9 inches were mature. Tagging studies provided estimates of survival and mortality rates for partially vulnerable and fully vulnerable segments of the population. Completely vulnerable fish (over 8.5 inches FL) exhibited a total annual mortality of 57%. Mortality due to fishing was 33%. (Authors)

9600. Calaprice, John R., and John E. Cushing (Calif. Dept. Fish and Game, San Diego, Calif.). 1967. A SEROLOGICAL ANALYSIS OF THREE POPULATIONS OF GOLDEN TROUT, Salmo aguabonita Jordan. Calif. Fish and Game, 53(4): 273-281.

Three populations of golden trout were compared using erythrocyte antigens. Two of the populations are from streams isolated from one another and within the ancestral home range of the species: Golden Trout Creek and South Fork of the Kern River. The third, from the originally barren Cottonwood Lakes, was started with 12 trout introduced from the South Fork of the Kern River some 90 years earlier. The populations were compared using agglutination scores and the distinction coincided with historic considerations. Golden trout from Golden Trout Creek differed significantly from both Cottonwood Lakes and South Fork of the Kern River goldens, while no significant difference was detected between goldens from the Cottonwood Lakes and the South Fork of the Kern River. (Authors)

9601. Fulmer, Bruce A., and Richard L. Ridenhour (Humboldt State College, Arcata, Calif.). 1967. JAW INJURY AND CONDITION OF KING SALMON. Calif. Fish and Game, 53(4): 282-285. Illus.

Examination of 84 fall-run king (chinook) salmon, Oncorhynchus tshawytscha, caught in the Mad and Eel Rivers of California during 1965 showed a significant negative relationship between healed jaw injuries and condition factor. Among uninjured and slightly injured fish, age, sex, and stream showed no significant relationship with condition but a significant decrease in condition was noted as the season progressed, and as the color of the fish darkened. Serious effects of the ocean troll fishery beyond direct hooking mortality are implied and warrant additional study. (Authors)

9602. Topp, Robert W. (Dept. Fishes, Museum Comparative Zoology, Harvard Univ., Cambridge, Mass.). 1967. AN INTERNAL CAPSULE FISH TAG. Calif. Fish and Game, 53(4): 288-289. Illus.

A fish tag in the form of a capsule inserted into the coelom has proved successful in aquarium tests on rock bass, Ambloplites rupestris. The tag consists of a message enclosed in a plastic capsule to which a flat flexible streamer is attached. It combines the advantages of the hydrostatic capsule and the body cavity tag. (Auth.)

9603. Thorson, Kenneth N. (Bureau of Commercial Fisheries, Seattle, Wash.). 1967. A NEW HIGH-SPEED TAGGING DEVICE. Calif. Fish and Game, 53(4): 289-292. Illus.

A new tagging method which uses molded plastic tags and an applicator much like a ticket punch in size and action was tested on fish. In use, the applicator implants a tag through a slotted needle into the fish by compressing the grip; upon

release a new tag is advanced for implant. A T-bar on the tag prevents it from being withdrawn with the applicator, or later lost by the fish. A tagging rate of 50 fish per minute was found to be possible. (Auth.)

9604. Hulquist, Robert G. (Calif. Dept. Fish and Game, Chino, Calif.). 1967. FIRST RECORDED XANTHIC SARGO, Anisotremus davidsonii (Steindachner), FROM THE SALTON SEA, CALIFORNIA. Calif. Fish and Game, 53(4): 292-293. Illus.

The first reported xanthic sargo, Anisotremus davidsonii (Steindachner) from the Salton Sea was taken by an angler on March 25, 1965. The fish measured 247 mm SL, and weighed 550 g frozen. It is now in the collection of the Scripps Institution of Oceanography at La Jolla (SIO 65-544-44A). (Auth.)

9605. Miller, Lee W. (Calif. Dept. Fish and Game, Sacramento, Calif.). 1967. A HEAVY INFESTATION OF THE THREADFIN SHAD, Dorosoma petenense, BY THE YELLOW GRUB, Clinostomum marginatum, IN EL CAPITAN RESERVOIR, SAN DIEGO COUNTY, CALIFORNIA. Calif. Fish and Game, 53(4): 293-295.

Metacercarial cysts were enumerated from 66 threadfin shad. Larger, older shad 5.0-7.9 inches TL averaged 19.9 cysts per fish. Smaller shad 2.0-4.9 inches TL averaged only 0.33 cysts per fish. There was a significant correlation between fish length and number of parasites. A host list, prepared by the author, indicates that this fish is a new host record. (Auth.)

9606. Wild, Paul W. (Calif. Dept. Fish and Game, Menlo Park, Calif.). 1967. AN OCCURRENCE OF A CHUM SALMON, Oncorhynchus keta (Walbaum), IN THE CALIFORNIA TROLL FISHERY. Calif. Fish and Game, 53(4): 299-300.

Chum salmon have been recorded as far south as Del Mar, California, but are rarely taken in California waters. On August 21, 1966, a maturing male chum salmon was taken by a commercial troller off Tomales Point, California. This is apparently the first record of a chum in the California troll fishery. (Auth.)

9607. Haw, Frank, and Raymond M. Buckley (Wash. Dept. of Fisheries, Seattle, Wash.). 1968. THE ABILITY OF WASHINGTON ANGLERS TO IDENTIFY SOME COMMON MARINE FISHES. Calif. Fish and Game, 54(1): 43-48. Illus.

The practicability of management schemes and accuracy of voluntarily submitted catch data may depend on identification of fishes by anglers. A survey using fresh specimens of common marine fishes, involving 909 Washington salmon anglers, was conducted and responses tabulated. Small (16 cm-52 cm FL) chinook (Oncorhynchus tshawytscha) and coho salmon (O. kisutch) comprised 75% of the test specimens. The other fishes used were copper rockfish (Sebastodes caurinus), lingcod (Ophiodon elongatus), rock sole (Lepidopsetta bilineata), Pacific sanddab (Citharichthys sordidus), Pacific cod (Gadus macrocephalus), Pacific staghorn sculpin (Leptocottus armatus), shiner perch (Cymatogaster aggregata), and sablefish (Anoplopoma fimbria). Results of the survey demonstrated: prevalent inability of anglers to identify the fishes listed above; improved recognition of chinook salmon after receiving a simple clue; more difficulty in recognition of smaller coho salmon than larger ones; infrequent use of recommended common names. (Authors)

9608. Wright, Thomas D., and Arthur D. Hasler (Laboratory of Limnology, Dept. of Zoology, Univ. of Wisconsin, Madison, Wisc.). 1967. AN ELECTROPHORETIC ANALYSIS OF THE EFFECTS OF ISOLATION AND HOMING BEHAVIOR UPON THE SERUM PROTEINS OF THE WHITE BASS (Roccus chrysops) IN WISCONSIN. The American Naturalist, 101(921): 401-402.

An electrophoretic analysis of the serum proteins of white bass (Roccus chrysops) populations in several Wisconsin lakes indicates that both homing behavior and geographic distance are effective isolating mechanisms for this species. Small populations tend to be less similar to each other than to very large populations. This is probably due to large populations displaying a larger number of phenotypes and to large populations presenting a greater degree of genetic diversity.

Homing behavior appears sufficient to maintain two populations within a single lake. It is suggested that the ability to return consistently to a specific spawning ground in a lake confers a selective advantage in that it leads to a maximum annual production of young. In order to validate the techniques employed in comparing populations, they were compared to a single population of another species, Roccus mississippiensis. The results of these comparisons are consistent and also indicate that some alteration of the gene pool of the white bass may have occurred through hybridization with R. mississippiensis. The degree of alteration seems to be dependent upon the length of time that the two species have been in contact. (Auth. summ.)

9609. Lake, J.S. 1967. REARING EXPERIMENTS WITH FIVE SPECIES OF AUSTRALIAN FRESHWATER FISHES. I. INDUCEMENT TO SPAWNING. Aust. J. mar. Freshwat. Res., 18(2): 137-153.

Experimental work on the reproduction of five species of fish endemic to Australia indicates the importance of specific water temperatures and floods as triggering mechanisms for spawning and for subsequent survival of young. Evidence has been obtained which suggests that the factor which stimulates the fish to spawn is produced when water comes into contact with dry soil. The species studied were Tandanus tandanus, Plectroplites ambiguus, Maccullochella macquariensis, Bidyanus bidyanus, and Carassiops klunzingeri. The spawning of these species is compared with some observations made on the heterochthonous Perca fluviatilis. Plectroplites ambiguus and Bidyanus bidyanus spawn at water temperatures above 23° C provided there is an accompanying rise in water level; both species produce pelagic eggs. Tandanus tandanus spawns at a temperature of 24° C and demersal eggs are laid in a gravel nest; a rise in water level is not essential. Maccullochella macquariensis spawns at 20° C provided there is a slight "run off" of water into the pond; eggs are laid in hollow logs or in similar situations. Carassiops klunzingeri spawns at 22.5° C and the eggs adhere to grass and twigs at the water's edge. Perca fluviatilis spawns at 11.5° C and all fish spawn in ponds over a short period if additional water is added, this ensures a more uniform water temperature throughout the pond. (Auth. summ.)

9610. Lloyd, R., and W.R. White. 1967. EFFECT OF HIGH CONCENTRATIONS OF CARBON DIOXIDE ON THE IONIC COMPOSITION OF RAINBOW TROUT BLOOD. Nature, 216(5122): 1341-1342.

Rainbow trout were transferred from normal aerated water to test aquaria containing high concentrations of carbon dioxide. Fish then were removed at fixed intervals and a sample of cardiac blood taken and analyzed for sodium, bicarbonate, chloride and phosphate. With 35 ppm free CO_2 in the water, the bicarbonate rose from the control level of 6.75 meq/l to 32.2 meq/l within 24 hours and to 39.5 meq/l with 65 ppm free CO_2 water. Chloride levels fell from 152.5 meq/l to 114.6 meq/l after 24 hours at 35 ppm free CO_2 and to 110.0 meq/l at 65 ppm free CO_2. Neither sodium or inorganic phosphate levels differed significantly from controls. On removal of the high level of free CO_2 from the water, the serum bicarbonate and chloride levels returned towards normal levels but curves flatten out after one hour. Even after 3 hours, chloride was still 20.5 meq/l lower and bicarbonate 8.7 meq/l greater than controls indicating some other anionic component (s) of 12 meq/l was present. Thus, the decreased serum chloride: sodium ratio accompanied by an increased bicarbonate and an unknown anionic component (s) can result from environmental stress unrelated to osmotic adaptation. --Charles R. Walker

9611. Hunn, Joseph B. (Bureau of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1967. BIBLIOGRAPHY ON THE BLOOD CHEMISTRY OF FISHES. Bureau of Sport Fisheries and Wildlife Research Report 72. 32 p.

More than 850 references on the chemistry of fish blood are listed as a guide to the widely scattered literature on the subject. (Auth.)

9612. Sund, Paul N., and William J. Richards (Tropical Atlantic Biological Lab., Bureau of Commercial Fisheries, Miami, Fla.). 1967. PRELIMINARY REPORT ON THE FEEDING HABITS OF TUNAS IN THE GULF OF GUINEA. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 551. 6 p.

The stomachs of 171 yellowfin tuna (Thunnus albacares) and 72 skipjack tuna (Katsuwonus pelamis), captured in the Gulf of Guinea, contained mostly fishes, cephalopods, and crustaceans. The percentage composition by volume of these three food categories was: 55, 19, and 8 for yellowfin tuna; 96, 1, and 2 for skipjack tuna. The percentage frequency of occurrence was: 76, 40, and 53 for yellowfin tuna; 73, 14, and 22 for skipjack tuna. The occurrence of forage species varied little in geographic areas within the region, but differences did occur between the food species found in stomachs of fish captured in the "warm" and "cool" seasons. A trematode parasite of the genus Hirudinella was found in stomachs of both tuna species. (Authors)

9613. May, Edwin B., and Charles R. Gasaway. 1967. A PRELIMINARY KEY TO THE IDENTIFICATION OF LARVAL FISHES OF OKLAHOMA, WITH PARTICULAR REFERENCE TO CANTON RESERVOIR, INCLUDING A SELECTED BIBLIOGRAPHY. Oklahoma Fishery Research Laboratory Bulletin Number 5. 32 p. Appendix.

An illustrated key useful for the identification of larval fresh-water fishes from Canton Reservoir, Oklahoma, is presented. Other Oklahoma species were also considered in the construction of the key to increase its usefulness in other areas and its value as a basis for future studies. More precise terminology has been defined for the early life history stages based on presence or absence of yolk and degree of fin development. Problems encountered and methods used in this study are discussed. A brief summary of development of larval fishes is also included. A partial bibliography useful for identification and study of larval fishes has been compiled. (Authors)

9614. Willford, Wayne A. (Bureau of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1967. INVESTIGATIONS IN FISH CONTROL 18. TOXICITY OF 22 THERAPEUTIC COMPOUNDS TO SIX FISHES. Bureau of Sport Fisheries and Wildlife Resource Publication 35. 10 p.

Of 22 therapeutic chemicals (18 parasiticides and 4 oral bacteriostats) tested by bioassays, 16 were toxic to fish and 6 were not. Tests were in 24- and 48-hour static bioassays on rainbow, brown, brook, and lake trout and bluegills at 12° C and channel catfish at 17° C. The 16 toxic chemicals, in descending order, were malachite green, Trolene, CoRal, Tiguvon, Roccal, P.M.A., Acriflavine, amopyroquin dihydrochloride, merthiolate, methylene blue, Neguvon, Ruelene, TV-1096, nickel sulfate, formalin, and quinacrine hydrochloride; the 6 that did not appear to be toxic were erythromycin thiocyanate, quinine hydrochloride, Flagyl, sulfamerazine, sulfamethazine, and sulfizoxazole. (Auth.)

9615. Marking, Leif L., and James W. Hogan (Bureau of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1967. INVESTIGATIONS IN FISH CONTROL 19. TOXICITY OF BAYER 73 TO FISH. Bureau of Sport Fisheries and Wildlife Resource Publication 36. 13 p.

Bayer 73, a molluscicide sold commercially as Bayluscide, is highly toxic to 18 species of freshwater fish. Various temperatures and water qualities in static bioassays do not influence the toxicity greatly, but pH variations in chemically buffered solutions do. The biodegradability, efficacy, and relative safety of Bayer 73 in aquatic situations indicate possible usefulness as a general fish toxicant. (Authors)

9616. Willford, Wayne A. (Bureau of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1967. INVESTIGATIONS IN FISH CONTROL 20. TOXICITY OF DIMETHYL SULFOXIDE (DMSO) TO FISH. Bureau of Sport Fisheries and Wildlife Resource Publication 37. 8 p.

Toxicities of dimethyl sulfoxide (DMSO) to rainbow trout, brook trout, lake

trout, carp, black bullhead, channel catfish, green sunfish, bluegill, and yellow perch were determined in 24-, 48-, and 96-hour static bioassays at 12° C. Toxicity was of low order, around 30 ppt. Water quality had little effect, but increased temperature increased the toxicity to rainbow trout. A preliminary test indicated that DMSO has little effect on the toxicity of antimycin to bluegill. (Auth.)

9617. Hesselberg, Robert J., and Ralph M. Burress (Bureau of Sport Fisheries and Wildlife, Southeastern Fish Control Lab., Warm Springs, Ga.). 1967. INVESTIGATIONS IN FISH CONTROL 21. LABOR-SAVING DEVICES FOR BIOASSAY LABORATORIES. Bureau of Sport Fisheries and Wildlife Resource Publication 38. 8 p.

Three inexpensive pieces of labor-saving apparatus for bioassay laboratory use are described and illustrated. Construction features, material costs, and use of a jar rinser, automatic liquid measuring vessel, and jar emptier are discussed. (Authors)

9618. Kennedy, Harry D. (Bureau of Sport Fisheries and Wildlife, Sierra-Nevada Aquatic Research Lab., Bishop, Calif.). 1967. SEASONAL ABUNDANCE OF AQUATIC INVERTEBRATES AND THEIR UTILIZATION BY HATCHERY-REARED RAINBOW TROUT. Bureau of Sport Fisheries and Wildlife Technical Paper 12. 41 p.

A 2-year study of the composition of the bottom fauna, its seasonal and annual variations, and its utilization by hatchery-reared rainbow trout was made in experimental stream channels of Convict Creek, Mono County, Calif. Three orders of aquatic invertebrates, Trichoptera, Coleoptera, and Ephemeroptera, comprised 70 percent of the total bottom fauna. Caddisflies were most numerous. Analysis of 289 rainbow trout stomachs indicated that Trichoptera, Ephemeroptera, and Diptera made up 75 percent of the total number of insects ingested. The trout relied heavily on dipterous insects in summer and on caddisflies in winter. Terrestrial insects were an important food source between June and November but were absent from the diet between December and February. An average square foot of bottom area contained approximately 9.5 times the number and a little more than 7 times the volume of food organisms per stomach. Gross comparisons were made of the distribution and abundance of the aquatic fauna with water velocity, mean depth, and substrate particle size. Forage ratios and frequency of occurrence of the primary food organisms are given. Post-hatchery survival of rainbow trout in small high altitude streams appears to be more dependent upon the physical condition of the trout at time of stocking than on a highly favorable physical environment. (Auth.)

9619. Fowler, Laurie G., and Joe L. Banks (Bureau of Sport Fisheries and Wildlife, Salmon-Cultural Lab., Longview, Wash.). 1967. TEST OF DIFFERENT COMPONENTS IN THE ABERNATHY SALMON DIET. Bureau of Sport Fisheries and Wildlife Technical Paper 13. 18 p.

Substitute components in the Abernathy salmon diet were tested in 2 years of feeding trials with fall chinook salmon fingerlings (Oncorhynchus tshawytscha). These diet tests indicated that turbot meal and dogfish meal were adequate substitutes for salmon meal. Soybean oil was superior to peanut, corn, cottonseed, or safflower oil. Corn gluten, safflower, or soybean meals were inadequate substitutes for cottonseed meal. Dried buttermilk was equal to dried skim milk. The amount of dried skim milk or wheat germ meal could not be reduced without deleterious effects. The mixed diet could be stored under refrigeration for 3 days and the premixed meals could be held at room temperature for several weeks without observable deleterious effect on the fish; storage for greater periods was deleterious. (Authors)

9620. Lennon, Robert E. (Bureau of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1967. BROOK TROUT OF GREAT SMOKY MOUNTAINS NATIONAL PARK. Bureau of Sport Fisheries and Wildlife, Technical Paper 15. 18 p.

The brook trout (Salvelinus fontinalis) of Great Smoky Mountains National Park are relatively scarce and are found only in remote, headwater streams. They are also small and short-lived. Males outnumber females, especially among sexually mature fish. The fecundity is lower than in fish of comparable size in Wisconsin and Canadian waters. Red spots on the sides of the trout are smaller but more numerous than on northern fish. Selected body parts appear to be larger than on Canadian fish. The southern trout are more susceptible to furunculosis and ulcer disease than northern fish. They survived and reproduced when stocked in Park waters where northern brook trout had failed, but failed when planted in streams of Shenandoah National Park in Virginia. On the basis of findings, it appears legitimate to consider the southern Appalachian brook trout a distinct strain. The brook trout in the Park have not extended their range downstream within the past 30 years. The soft, acid headwaters in which they live are relatively infertile. Water temperatures in winter are limiting because the streams freeze severely and extensively. Water temperatures may remain at 32° F for several days, anchor ice forms in the streams, and flows are reduced. At such times, the redds of brook trout may become dewatered and frozen. Under present conditions, any increase in exploitation of the brook trout in the Park or damaging alteration of the habitat might have serious consequences for the remnant populations.

9621. Eisler, Ronald (Bureau of Sport Fisheries and Wildlife, Fish-Pesticide Program, Sandy Hook Marine Lab., Highlands, N.J.). 1967. TISSUE CHANGES IN PUFFERS EXPOSED TO METHOXYCHLOR AND METHYL PARATHION. Bureau of Sport Fisheries and Wildlife Technical Paper 17. 15 p.

Adult northern puffers were exposed for periods up to 45 days to either 30 parts per billion (ppb) of the organochloride insecticide methoxychlor, 20,200 ppb of the organophosphorous insecticide methyl parathion, or to a combination of 15 ppb of methoxychlor and 10,100 ppb of methyl parathion. These concentrations will produce approximately 5 percent mortality in 96 hours under the conditions of the experiment. Periodically, fish from each group were analyzed for whole blood and serum constituents and for content of sodium, potassium, calcium, magnesium, zinc, and iron in selected tissues. Puffers subjected to 30 ppb of methoxychlor remained as active as the controls, ate readily when offered shucked clams, and experienced no significant mortality. No statistically significant differences at the 0.01 level were observed between methoxychlor-exposed puffers and controls for any of the parameters investigated. Groups exposed to methyl parathion alone, or to methyl parathion in combination with methoxychlor, refused to eat during the study, were sluggish and, after exposure for 96 hours, exhibited a rapid increase in the rate of death. Survivors, when compared to controls, had less hemoglobin, erythrocytes, a lower hematocrit, complete inhibition of serum esterase enzymes, less magnesium in liver, and less zinc in liver and in gill filament; these differences were significant at the 0.01 level. Profiles were constructed based on the effects of each insecticide on blood and tissue components. The visual patterns provided by these profiles suggest a means of identifying unfavorable environmental conditions before the appearance of obvious morphological or physiological changes. (Auth.)

9622. Charnell, Robert L., David W. K. Au, and Gunter R. Seckel. 1967. THE TRADE WIND ZONE OCEANOGRAPHY PILOT STUDY PART V: TOWNSEND CROMWELL CRUISES 14 AND 15 MARCH AND APRIL 1965. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 556. 54 p.

A standard grid of oceanographic stations in an area bounded by lat. 10° and 26° N., and long. 148° and 157° W., was occupied at monthly intervals between February 1964 and June 1965. For the fifth set of two cruises, Townsend Cromwell cruises 14 and 15, March and April 1965, oceanographic station data are tabulated, BT data are presented in vertical sections, and the distribution of surface temperature, surface salinity, and surface dynamic height relative to 1,200 m are shown in charts for each cruise. Methods and procedures as well as the limitations of the data are discussed. (Authors)

9623. Charnell, Robert L., David W. K. Au, and Gunter R. Seckel. 1967. THE TRADE WIND ZONE OCEANOGRAPHY PILOT STUDY PART VI: TOWNSEND CROMWELL CRUISES 16, 17, AND 21 MAY AND JUNE 1965 AND JANUARY 1966. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 557. 59 p.

A standard grid of oceanographic stations in an area bounded by lat. 10° and 26° N., and long. 148° and 157° W., was occupied at monthly intervals between February 1964 and June 1965. For the last regular cruises, Townsend Cromwell cruises 16 and 17, May and June 1965, oceanographic station data are tabulated, BT data are presented in vertical sections, and the distribution of surface temperature, surface salinity, and surface dynamic height relative to 1,200 m are shown in charts for each cruise. Methods and procedures as well as the limitations of the data are discussed. Oceanographic station data from Townsend Cromwell cruise 21 in January 1966, consisting of a single profile of stations between lat. 10° and 26.5° N. along long. 154° W., have been included. (Authors)

9624. Saur, J. F. T., and Dorothy D. Stewart (Bureau of Commercial Fisheries Biological Lab., Stanford, Calif.). 1967. EXPENDABLE BATHYTHERMOGRAPH DATA ON SUBSURFACE THERMAL STRUCTURE IN THE EASTERN NORTH PACIFIC OCEAN. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 548. 70 p.

This report contains reproductions of original temperature-depth traces, two temperature sections, and synoptic weather observations taken between San Francisco and Honolulu in November-December 1965, using an expendable bathythermograph system aboard a merchant ship. A third temperature section derived from closely spaced observations shows the complicated temperature structure with temperature maximums and minimums over a distance of about 45 nautical miles (85 km) across the outer boundary of the California Current. (Authors)

9625. Kato, Susumu, Stewart Springer, and Mary H. Wagner (Bureau of Commercial Fisheries Tuna Resources Lab., La Jolla, Calif.). 1967. FIELD GUIDE TO EASTERN PACIFIC AND HAWAIIAN SHARKS. U.S. Fish and Wildlife Service Circular 271. 47 p. Illus.

Illustrations, descriptions, and keys to the identification of more than 70 species of sharks are presented. (Authors)

9626. Lennon, Robert E. (Bureau of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1967. CLEARANCE AND REGISTRATION OF CHEMICAL TOOLS FOR FISHERIES. Progressive Fish-Culturist, 29(4): 187-193.

Legislation passed by the U.S. Congress in recent years requires that drugs, pesticides, and chemicals be safe, efficacious, and registered for specific uses. The chemical tools used in fisheries, such as toxicants, anesthetics, and medications, fall under the new regulations. The tests necessary to demonstrate the safety, efficacy, and residues of fishery chemicals are indicated. (Auth.)

9627. Haley, Richard, Sterling P. Davis, and Jackson M. Hyde (California Dept. of Fish and Game, Sacramento, Calif.). 1967. ENVIRONMENTAL STRESS AND Aeromonas liquefaciens IN AMERICAN AND THREADFIN SHAD MORTALITIES. Progressive Fish-Culturist, 29(4): 193.

Aeromonas liquefaciens was established as the lethal agent in a kill of threadfin shad (Dorosoma petenense) and American shad (Alosa sapidissima), although stress brought on by very low dissolved oxygen levels (1.2 to 2.6 ppm) was the probable cause of the epizootic. (Authors)

9628. Freeman, R. I., D. C. Haskell, D. L. Longacre, and E. W. Stiles (New York State Conservation Dept., Bath, N. Y.). 1967. CALCULATIONS OF AMOUNTS TO FEED IN TROUT HATCHERIES. Progressive Fish-Culturist, 29(4): 194-209.

Two methods of calculating the amount to feed, both in use in New York State trout hatcheries, are presented. The first is based on calculations from predicted percentage gain and conversion; the second depends on a prediction of the

rate of length increase and the calories required per pound of growth. Included are tables which are useful in applying the new methods, and a nomogram relating values of percent body weight fed, conversion, and percent gain. (Authors)

9629. Buterbaugh, Galen L., and Harvey Willoughby (Bureau of Sport Fisheries and Wildlife, Portland, Oreg.). 1967. A FEEDING GUIDE FOR BROOK, BROWN, AND RAINBOW TROUT. Progressive Fish-Culturist, 29(4): 210-215.

A proved method of determining the amount of food to feed trout is presented.

$$\% \text{ of body weight to feed daily} = \frac{\text{hatchery constant}}{\text{average length of fish (inches)}}$$

The hatchery constant is determined from records of food conversion and average daily growth. Tables for feeding brook, brown, and rainbow trout are included. (Authors)

9630. Johnson, M. G., and H. R. McCrimmon (University of Guelph, Guelph, Ont., Canada). 1967. SURVIVAL, GROWTH, AND REPRODUCTION OF LARGEMOUTH BASS IN SOUTHERN ONTARIO PONDS. Progressive Fish-Culturist, 29(4): 216-221.

Fingerling largemouth bass (Micropterus salmoides) were stocked in combination with: the bluegill (Lepomis macrochirus), the fathead minnow (Pimephales promelas), the golden shiner (Notemigonus crysoleucas), with established coarse fish populations, and as the only fish species. An average of 60% of the bass survived to age 1, and 42% to age 2 years. Survival was similar among all species combinations except one: survival of bass was significantly poorer with coarse fish. Bass had greatest growth rates with bluegills and coarse fish, showed the least gain with golden shiners, and alone or with fathead minnows showed intermediate growth. Growth rate varied inversely with numbers per acre and was related directly to total phosphorus concentrations in one set of ponds. Bass spawned at the age of 2 years. Abundance and size of native fall fingerlings were independent, respectively, of number of breeding bass and number of fingerlings. (Authors)

9631. Bulow, Frank J. (Southern Illinois Univ., Carbondale, Ill.). 1967. THE SUITABILITY OF STRIP-MINE PONDS FOR PRODUCING MARKETABLE CHANNEL CATFISH. Progressive Fish-Culturist, 29(4): 222-228.

The feasibility of rearing pellet-fed channel catfish (Ictalurus punctatus) in chemically suitable strip-mine ponds was demonstrated. In July and October 1964, 1/2-oz channel catfish were stocked in 8 strip-mine ponds and fed floating trout pellets at a daily rate of 3% of body weight. Several of these ponds were also stocked with fathead minnows (Pimephales promelas). No feeding occurred while water temperatures were below 50° (November to April). By September 1965, channel catfish stocked in July averaged 1.57 lb and those stocked in October averaged 0.66 lb. A stocking rate of 2,000 channel catfish per acre, with fathead minnows, resulted in the best survival (90.6%) and production (3,194 lb per acre). The presence of fathead minnows resulted in higher production but poorer food conversion for channel catfish. Large poundages of fish (4,000 lb per acre) and high feeding rates (50 to 60 lb per acre) were tolerated in ponds without oxygen deficiences. A 1/4-inch mesh tarred seine (3 to 1 seine to water depth ratio) was efficient in harvesting strip-mine ponds free of obstructions. The channel catfish were highly catchable, of good sporting quality, and excellent in flavor. (Auth.)

9632. Lewis, William M., and M. Gene Ulrich (Southern Illinois Univ., Carbondale, Ill.). 1967. CHLORINE AS A QUICK-DIP TREATMENT FOR THE CONTROL OF GYRODACTYLIDS ON THE GOLDEN SHINER. Progressive Fish-Culturist, 29(4): 229-231.

A 3.5-ppt chlorine solution as a 10-second dip gave complete control of the member of the Gyrodactylus elegans complex which is an important parasite of the golden shiner (Notemigonus crysoleucas). This method is recommended for treatment of fish during interpond transfer and when gyrodactylid epizootics occur while fish are being held in tanks. (Authors)

9633. Martin, John Wilson (Bureau of Commercial Fisheries, Biological Lab., Auke Bay, Alaska). 1967. A METHOD OF MEASURING LENGTHS OF JUVENILE SALMON FROM PHOTOGRAPHS. Progressive Fish-Culturist, 29(4): 238-240.

A method of photographing live juvenile salmon and determining their lengths from mechanical interpretation of the photographs is described. Lengths are calculated from the sum of a series of chords measured with dividers along body curves of the fry. (Auth.)

9634. Swedberg, Donald (Bureau of Sport Fisheries and Wildlife, Yankton, S. D.). 1967. A TRAWLING DEVICE FOR SMALL BOATS. Progressive Fish-Culturist, 29(4): 241-242.

A trawling device that can be mounted in an 18-foot aluminum boat powered by twin 40-horsepower outboard engines is described.

9635. Rachlin, Joseph W., Alfred Perlmutter, and Robert J. Seeley (New York Univ., Graduate School of Arts and Sciences, New York, N. Y.). 1967. MONOLAYER CULTURE OF GONADAL TISSUE OF THE ZEBRA DANIO. Progressive Fish-Culturist, 29(4): 232-234.

The procedure and techniques for preparing short-term monolayer cultures of the gonads of adult female zebrafish (Brachydanio rerio) in normal mammalian tissue culture medium are described. The use of these tissue cultures to study the effects of environmental alterations on cell systems is briefly discussed. (Authors)

9636. Voth, David R., and Omer R. Larson (Dept. of Biology, Univ. of North Dakota, Grand Forks, N. D.). 1968. METAZOAN PARASITES OF SOME FISHES FROM GOOSE RIVER, NORTH DAKOTA. Amer. Midl. Nat., 79(1): 216-224.

One hundred-five fishes representing 10 species (Catostomus commersoni, Esox lucius, Etheostoma nigrum, Perca flavescens, Notropis cornutus, Pimephales promelas, Semotilus atromaculatus, Lepomis macrochirus, Pomoxis nigromaculatus, Ictalurus melas) were collected from two sites along the Goose River in eastern North Dakota during the summer and autumn of 1964. Thirty genera or species of parasites were identified, and in no instance was a fish uninfected. Posthodiplostomum minimum centrarchi, Neascus pyriformis, Diplostomulum scheuringi, Phyllodistomum staffordi, Microphallus opacus, Allocreadium ictaluri, Alloglossidium corti, Proteocephalus pinguis, Corallobothrium sp., Spinitectus carolini, Camallanus oxycephalus, Neoechinorhynchus saginatus, Octospinifer macilentis, Argulus sp., Ergasilus versicolor and Achtheres ambloplitis are reported from North Dakota fishes for the first time. (Authors)

9637. Eddy, F. B. (Salmon and Freshwater Fisheries Lab., MAFF, London, England). 1968. THE DEVELOPMENT AND HATCHING OF SALMON EGGS IN DILUTIONS OF SEA WATER. Salmon and Trout Magazine, No. 182. pp. 30-33.

It was concluded that if salmon spawn is deposited in water with a salinity exceeding 12.5 percent, due either to estuarine conditions or saline pollution, then the effect on the eggs and alevins is likely to be detrimental. In otherwise favorable conditions, and with the salinity below 12.5 percent, the eggs and alevins could be expected to develop successfully.

9638. Higer, Aaron L., and Milton C. Kolipinski (U. S. Department of the Interior, Water Resources Div., Geological Survey, Miami, Fla.). 1967. PULL-UP TRAP: A QUANTITATIVE DEVICE FOR SAMPLING SHALLOW-WATER ANIMALS. Ecology, 48(6): 1008-1009.

A trap was designed for providing quantitative samples of freeswimming animals in marshes and shallow ponds. The device consists of netting tied to an aluminum frame with attachments for rapidly raising the net and entrapped organisms out of the water. Collections from a series of pull-up traps, operated monthly in Everglades National Park, provide an index of fluctuations in aquatic animal populations. (Authors)

9639. Toetz, Dale W. (Dept. of Zoology, Oklahoma State Univ., Stillwater, Okla.). 1967. THE IMPORTANCE OF GAMETE LOSSES IN MEASUREMENTS OF FRESHWATER FISH PRODUCTION. Ecology, 48(6): 1017-1020.

Changes in the maturity, weight and chemistry of ovaries of bluegills, Lepomis macrochirus, taken from Pewaukee Lake, Wisconsin, were observed during the summer of 1963. In June all ovaries were either in spawning condition or very close to this stage; by September all were completely spent. Between June and September the average ovary of an age-group-II female decreased in wet weight from 8.7 to 1.9 g, a decrease of 6.8 g (2.5 g dry weight). Protein accounted for 1.7 g of the decrease in dry weight whereas fat accounted for about 0.7 g. These losses are compared with the body weight of the fish and annual growth by individuals. Protein loss as spent ova was calculated to be about 13% of the total somatic protein of a spawning female and about 24% of the somatic protein gained by the fish as annual growth during the previous year. The substantial losses of protein as spent gametes are discussed relative to estimates of production by freshwater fish populations. (Auth.)

9640. Lewis, William M., and Stephen Flickinger (Southern Illinois Univ., Carbondale, Ill.). 1967. HOME RANGE TENDENCY OF THE LARGEMOUTH BASS (Micropterus salmoides). Ecology, 48(6): 1020-1023.

By repeated sampling of a population of largemouth bass, including individually marked fish, and by use of reference markers along the shoreline, the observance of a home range by the bass was demonstrated. Of 96 recaptures considered, 59% were recaptured within 100 ft, 83% within 200 ft, and 96% within 300 ft of the original point of capture. The extent of movement away from the initial point of capture did not increase with time. After being offshore over winter the bass again demonstrated a marked tendency to resume the use of the same segment of shoreline they had frequented the previous summer. Straying from the home range followed by return to it was also observed. Observations on the dispersion of bass along the shoreline are given. (Authors)

9641. Grizzell, Roy A., Jr. (U.S. Dept. of Agriculture, Soil Conservation Service, Little Rock, Ark.). 1966. DIURON AS AN AQUATIC HERBICIDE. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp.194-197.

9642. Mathis, W.P. (Arkansas Game and Fish Comm., Little Rock, Ark.). 1966. OBSERVATIONS ON CONTROL OF VEGETATION IN LAKE CATHERINE USING ISRAELI CARP AND A FALL AND WINTER DRAWDOWN. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 197-205.

Due to a combination of factors, Lake Catherine, a 3,000-acre reservoir which had never known a vegetation problem, suddenly became congested with rooted aquatic vegetation in 1960. The vegetation, mostly coontail, Ceratophyllum demersum, and Elodea sp., could be controlled with chemicals and consequently various chemicals were used by the riparian property owners on small localized areas. However, for the larger, main body of the lake, chemical herbicides were considered too expensive to be practical. In October 1960 the Arkansas Game and Fish Commission was petitioned both by the sportsmen in the area, the riparian property owners, and the Arkansas Power and Light Company (owners of the dam and reservoir), to advance a plan for the control of the vegetation. The formulation and the carrying out of that plan is discussed, with emphasis on the combination of two biological methods of control. (Auth.)

9643. Krisnandhi, Sulaeman, and Wayne Shell (Agricultural Experiment Station, Auburn Univ., Auburn, Ala.). 1966. UTILIZATION OF CASEIN AND SOYBEAN PROTEIN BY CHANNEL CATFISH, Ictalurus punctatus (Rafinesque). Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 205-209.

This research was conducted at the Fisheries laboratory at Auburn University Agricultural Experiment Station to determine the comparative value of casein, soybean protein, and a 1:1 combination of these two proteins in diets of channel catfish. The proteins or combination of proteins were fed at a 5 or 30 percent level.

The comparative values of the proteins were evaluated by growth rate of lots of 10 channel catfish held in troughs and fed the purified diets during a 10-week period. The growth rate data indicated that diets containing casein and the protein combination produced approximately equal growth and that both of these protein sources produced better growth than soybean protein alone. Fish receiving diets containing 30 percent protein gained at a significantly higher rate than fish receiving diets containing five percent protein. The relative order of growth rates for the three sources of protein was the same at both levels of protein in the diet. (Authors)

9644. Hackney, Peter A. (Auburn Univ. Agricultural Experiment Station, Auburn, Ala.). 1966. PREDATOR-PREY RELATIONSHIPS OF THE FLATHEAD CATFISH IN PONDS UNDER SELECTED FORAGE FISH CONDITIONS. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 217-222.

Flathead catfish (Pylodictis olivaris), ranging in size from 1.5 to 26 inches in length, were placed in experiments involving one or more forage species. Survival of 1.5 to 2.0-inch flathead fingerlings stocked into six ponds containing adult sunfishes and flathead minnows (Pimephales promelas) was low, ranging from 0 to 1.5 percent. Experiments conducted in plastic-lined pools to determine the vulnerability of four test species to predation by flathead catfish indicated a selection in order of decreasing vulnerability of largemouth bass (Micropterus salmoides), white catfish (Ictalurus catus), green sunfish (Lepomis cyanellus), and goldfish (Carassius auratus). Similar tests conducted in earthen ponds revealed an order of decreasing vulunerability of white catfish, largemouth bass, green sunfish, and goldfish although in neither experiment were all separations statistically significant. Adult flathead catfish (14 to 16-inch) stocked at a rate of 50 per acre into a pond containing a stunted bluegill (Lepomis macrochirus) population reduced but did not correct crowding within a 320-day period. Two ponds stocked with Tilapia spp. and large flathead catfish did not result in desirable populations as, at the time of draining, fish larger than the 5-inch group comprised less than 13.4 percent by weight of the tilapia populations. (Auth.)

9645. Lewis, William M., and John D. Parker (Fishery Research Lab. and Dept. of Zool., Southern Illinois Univ., Carbondale, Ill.). 1966. PARAFORMALDEHYDE FOR CONTROL OF Gyrodactylus AND Dactylogyrus. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 222-225.

9646. Burgess, J.E. (Florida State Board of Health, Winter Haven, Fla.). 1966. SOME EFFECTS OF CULTURAL PRACTICES ON AQUATIC ENVIRONMENTS AND NATIVE FISH POPULATIONS. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 225-235.

Cultural practices which either contribute nutrient materials to the ecosystem or accelerate detrition by induced recirculation of nutrients within the system result in environmental changes which persist after the practices have been discontinued. The effects of environmental modification were found to be reflected in species structure of native fish populations. The percent of centrarchids within the total population was found to occur in direct proportion to the percent of productive bottom. Macroinvertebrate organisms used as food by centrarchids were found to be restricted to certain bottom types. These studies confirm the conclusion of Eggleton (1933) that forces inherent in the substratum itself bend and shape all other forces and thus condition the reaction of both plants and animals. The role of submersed and floating vegetation as a substrate for invertebrate organisms is discussed. The harvest of fish as a means of reducing lake fertility (Thomas, 1965) was found to have merit. An estimated 24,352 pounds of phosphates as PO_4 was removed in the 1,151,161 pounds of fish harvested from Lake Harris, Lake County, Florida, during a 15 month population control study. Phosphorous removed from the lake in the harvested fish would have been equivalent to removing all phosphates from 91,207 acre feet of water at a 0.1 ppm concentration. (Auth.)

9647. Stubbs, John M. (Tennessee Game and Fish Comm., Nashville, Tenn.). 1966. ELECTRO FISHING, USING A BOAT AS THE NEGATIVE. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 236-245.

The use of an aluminum boat as the electrode on streams and rivers is quite simple and is as effective as the electrodes suspended from the side of a boat. This eliminates the need of any electrodes hanging over the side of the boat and allows the operator to work efficiently through trash and submerged obstacles. It is necessary, if using direct current or pulsed direct current, to connect the negative lead to the aluminum hull of the boat instead of to the electrodes suspended on each side. The individual items required and their use in this operation, e.g., variable voltage pulsating unit, modified negative and positive electrodes and others, are described. The cost of the unit, including boat, motor, trailer, variable voltage pulsator, miscellaneous and safety items, is approximately $2,000.00. Safety items are listed and described to assist in eliminating shock hazards. (Auth.)

9648. Swingle, Wayne E., R. Oneal Smitherman, and Sam L. Spencer (Alabama Dept. of Conservation, Fairhope, Ala.). 1966. ESTIMATION OF BASS NUMBERS IN A FARM POND PRIOR TO DRAINING WITH ELECTRO-SHOCKING AND ANGLING. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 246-253.

The number of largemouth bass (Micropterus salmoides) in a 3.5-acre experimental pond located at Auburn University Agricultural Experiment Station was estimated by mark and recovery techniques using both Schnabel and Peterson methods. Sampling was done with both electric shocker and angling. Estimates were made during two periods in 1962. Various estimates of the number of bass made in this study were fairly uniform. However, on draining the estimates were found to be in error by approximately 50 percent. Based on number of bass recovered at draining and the computed percentage of survival, the value of N for the first period (May 23, to December 20, 1962), was computed to be 604 bass, whereas the Schnabel and Peterson methods gave N values of 304 bass and 469 bass with percent errors of -49.7 and -22.4, respectively. The theoretical requirements of both methods seemed to be met for the first period. The value of N for the second period (August 1 to December 20, 1962) was computed to be 500 bass, whereas the Schnabel and Peterson methods gave N values of 381 bass and 313 bass with percent errors of -23.8 and 37.4, respectively. The requirements of no mortality for the Schnabel method was violated without any apparent loss of accuracy. Only with the Peterson method during the first period were the criteria of Robson and Regier (1964) satisfied for censuses with management applications. None of the censuses met their criteria for censuses with research applications. (Authors)

9649. Wegener, William L. (Florida Game and Fresh Water Fish Comm., Lakeland, Fla.). 1966. A TAG COMPARISON STUDY OF LARGEMOUTH BASS IN THEIR NATURAL ENVIRONMENT. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 258-264.

One thousand three hundred and forty-six largemouth bass were captured, tagged, and released in nineteen bodies of water throughout the State of Florida. Spaghetti, Petersen disc, and Monel metal strap tags were the principal tags employed. All fish caught by anglers were returned to the Game and Fresh Water Fish Commission for information regarding growth rates of which negative data was obtained. Comparisons were made of the percent returns of each of the three tags represented, plus the Spaghetti tag was compared in two different locations on the fish. The external effects on the recaptured fish showed either slight or heavy infections caused by the initial tag wound or by irritations of mechanical, chemical or biological origin. This study was made in conjunction with the Florida State-wide Fish Tagging Program sponsored by the Schlitz Brewing Company. (Auth.)

9650. Lowe, Jack I. (Bureau of Commercial Fisheries Biological Lab., Gulf Breeze, Fla.). 1966. SOME EFFECTS OF ENDRIN ON ESTUARINE FISHES. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 271-276.

Laboratory experiments were conducted to determine the acute and chronic effects of endrin to estuarine fishes. Short-term bioassays in flowing seawater determined 24-hour LC_{50}'s for spot (Leiostomus xanthurus), mullet (Mugil cephalus), menhaden (Brevoortia patronus), longnose killifish (Fundulus similis), and sheepshead minnows (Cyprinodon variegatus). A population of spot was exposed continuously for eight months to a sublethal concentration (0.05 ppb). No pathology was found in the spot after seven months of exposure, but a three-week exposure to a near-lethal concentration (approximately 0.075 ppb) produced pathology characterized by systemic lesions involving the brain and spinal cord, liver, kidneys and stomach. Residue analyses (gas chromatography) of spot exposed to 0.05 ppb endrin for five months revealed an accumulation of 78 ppb (micrograms/kilogram). No endrin could be detected in these fish after a 13-day holding period in uncontaminated water. Chronic exposure of spot to endrin did not affect their tolerance to sudden changes of salinity. Endrin-exposed fish were also able to endure extended periods of starvation. Sublethal concentrations of endrin do not appear to affect the general physical condition of spot. The threshold of toxicity is extremely critical and the importance of time must not be underestimated in determination of a sublethal concentration of endrin for fish. (Auth.)

9651. Lorio, Wendell J., and Harry E. Schafer. 1966. A FOOD HABIT STUDY OF THE SPOTTED SEATROUT, Cynoscion nebulosus, IN THE BILOXI MARSH AREA, LOUISIANA. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 289-296.

The spotted seatrout, Cynoscion nebulosus, are found throughout the year in the Biloxi Marsh Area in southeastern Louisiana. A total of 368 stomachs were analyzed; 152 were empty. Fish occurred in 74.4 percent of these stomachs and crustaceans in 25.3 percent. During the summer months fish and crustaceans were comparable in percent occurrence as food items. In this same period food availability samples showed that crustaceans had become more prevalent. This suggests a correlation of the food habits of the spotted seatrout to food availability. Fish seem to be the most important food group in the Biloxi Marsh Area utilized by the spotted seatrout. (Authors)

9652. Kelley, John R., Jr., and Dudley C. Carver. 1966. AGE AND GROWTH OF BLUE CATFISH, Ictalurus furcatus (LeSueur), IN THE RECENT DELTA OF THE MISSISSIPPI RIVER. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 296-299.

Age and growth of blue catfish, Ictalurus furcatus (LeSueur), collected on Delta National Wildlife Refuge, Venice, Louisiana, were determined by length frequency and the pectoral spine technique. Lengths calculated from pectoral spines agree with the length frequency mode for age I fish collected during January 1965. Three regressions were computed for the data and the cubic equation provided the best fit. This equation indicated that weight increased faster than the cube of the length. (Authors)

9653. Berger, Bernard L. (Bureau of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1966. ANTIMYCIN (FINTROL) AS A FISH TOXICANT. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 300-301.

9654. Little, James D. (Tennessee Game and Fish Comm., Nashville, Tenn.). 1966. RECLAMATION OF PINE CREEK, TENNESSEE. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 302-315.

Fish in Pine Creek, in DeKalb County, Tennessee, were eradicated with rotenone and brown trout were stocked in the stream. This management tool, stream reclamation, was evaluated by studying the growth rate of the brown trout, their condition, the rate at which other species of fish re-entered the stream, and the effect of the toxicant, rotenone, on the bottom fauna. Populations of bottom

dwelling organisms were reduced from 34 to 100 % by the rotenone. All organisms except two, Plecoptera and Isopoda, recovered up to or beyond their original abundance within one year after eradication. The brown trout had an average growth rate per month of 11 millimeters in length and 18.1 grams in weight during the 16-month study period. This growth rate was exceptional when compared to the growth rate of brown trout reported by other investigators and was equal to the growth rate of brown trout in a Tennessee hatchery. The coefficients of condition of the brown trout in Pine Creek were low in comparison to brown trout in other streams. These data indicate that reduction of competition results in increased growth rate of brown trout. Species of fish other than trout re-entered the stream approximately three months after eradication. Sixteen months after eradication, 12 of the 17 species of fish originally present in the stream had reappeared. (Auth.)

9655. Jackson, Sam W., Jr. (Water and Sewer Dept., Tulsa, Okla.). 1966. SUMMARY OF FISHERY MANAGEMENT ACTIVITIES ON LAKES EUCHA AND SPAVINAW, OKLAHOMA. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 315-343.

The City of Tulsa, Oklahoma, has long been a proponent of the multiple-use concept of its water resources; including approximately 5,000 surface acres of impounded water. These waters are: Lake Eucha (2,880 surface acres), also known as Upper Spavinaw, Delaware County, Oklahoma, Spavinaw Lake (1,637 surface acres), Mayes County, Oklahoma, and Lake Yahola (425 surface acres) Tulsa County, Oklahoma (Jackson, 1957). The fishery management program on the Spavinaw Lakes was initiated by A. D. "Bob" Aldrich in 1949 and has been expanded and continuous for a period of sixteen years. Although progress may have appeared slow at times during this period, the trend has been toward improved fishing and an improved fishable fish population. The rough fish removal program was initiated in 1949. During the past fourteen years (1951-1964), 436,513 fish weighing 163,265 pounds have been removed from Spavinaw Lake. During the past twelve years (1953-1964), 59,670 fish weighing 47,904 pounds have been removed from Lake Eucha. Age and growth studies were initiated on the Spavinaw Lakes in 1952. Growth trends indicate improvement in the growth of the more desirable species over the management period. Creel survey studies began in 1954 and trends indicate fishing has generally improved during the management period. On Spavinaw Lake, 90,000 fishermen spent 331,350 hours harvesting 322,250 fish at an average annual harvest rate of 19.7 fish weighing 23.7 pounds per surface acre over the ten year period 1955-1964. On Lake Eucha during the same 10-year period, 216,700 fishermen spent 1,075,600 hours harvesting 1,068,950 fish at an average annual harvest rate of 37.1 fish weighing 43.3 pounds per surface acre. Other management practices employed on the two lakes include: tagging studies on largemouth bass, establishment of fish concentration stations, identifying prominent landmarks, coves and hollows with signs, providing maps for fishermen, the construction of loading ramps and bank fishing piers. (Auth.)

9656. Muncy, Robert J. 1966. AGING AND GROWTH OF LARGEMOUTH BASS, BLUEGILL, AND REDEAR SUNFISH FROM LOUISIANA PONDS OF KNOWN STOCKING HISTORY. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 343-349.

Scales of largemouth bass taken from two ponds at Baton Rouge, Louisiana, over a three-year period agreed closely with the known past stocking history on these fish. Largemouth bass scales from a 50-acre pond at Clinton, Louisiana, indicated agreement with the six years fish had been stocked. Total length growth rates of bass were increased by controlled fall drawdown; however, prolonged summer droughts decreased total length growth and condition factors. Spawning and drastic drawdowns resulted in more pronounced growth checks than winter cessation on the scales of bluegill and redear sunfish from ponds of known stocking history. (Auth.)

9657. Brown, V. M., D. H. M. Jordan, and B. A. Tiller (Water Pollution Research Lab., Ministry of Technology, Stevenage, England). 1967. THE EFFECT OF TEMPERATURE ON THE ACUTE TOXICITY OF PHENOL TO RAINBOW TROUT IN HARD WATER. Water Research, 1(8/9): 587-594.

The resistance of rainbow trout to poisoning by phenol increases with increase in temperature up to at least 18° C, at which temperature the 48-hour LC_{50} is almost twice that at 6° C. A similar relationship exists with gas-liquor phenols. The response of test populations showed the least variability at 12° C. (Authors)

9658. Hughes, Janice S., and Neil H. Douglas (Louisiana Wild Life and Fisheries Comm., Monroe, La.). 1966. MOVEMENT OF NATIVE AND STOCKED FISH IN D'ARBONNE LAKE AFTER IMPOUNDMENT. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 349-364.

A total of 3,174 native fish of 29 species was tagged and released in Bayou D'Arbonne during the spring and summer of 1963. The distance and direction of movement of captured fish were recorded before inundation and again after the flooding of the 15,000-acre impoundment, D'Arbonne Lake, in January 1964. Of the 57 tagged fish returned before inundation, 54 were recaptured in the same location. One fish moved upstream for a distance of 3.3 miles and two fish moved downstream for an average distance of 6.8 miles. After the lake was filled, the fish exhibited extensive movements and only 11 percent of the returns occurred in release areas. Thirty-three of the 84 fish recaptured in the lake moved toward the headwaters while 35 fish moved toward the spillway. A total of 4.4 percent of the native fish tagged were recovered. Tagged hatchery reared bluegill, Lepomis macrochirus; largemouth bass, Micropterus salmoides; channel catfish, Ictalurus punctatus; and black crappie, Pomoxis nigromaculatus numbering 9,173 individuals were stocked in D'Arbonne Lake. The direction and distance of movement of these fish were also recorded. Sixty-one hatchery reared fish (0.7 percent) were recovered from the lake. Largemouth bass showed an upstream movement while 50 to 54 percent of the bluegill and channel catfish showed no movement. No tagged black crappie were recovered. A determination of the number of fish release sites necessary for stocking large impoundments was a primary objective. (Authors)

9659. Davis, James T., and Janice S. Hughes (Louisiana Wild Life and Fisheries Comm., Monroe, La.). 1966. EFFECTS OF IMPOUNDMENT ON THE BENTHIC POPULATION OF BAYOU D'ARBONNE, LOUISIANA. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 364-374.

The number and variety of the benthic organisms present in the stream prior to impoundment compares favorably with that presented by other authors. The families present seem to indicate a very low order of pollution in the study streams. The spread of the benthic populations over the newly inundated area as the lake reached pool stage indicates a more rapid expansion than that reported by other authors. Within one year after impoundment, it reached a level comparable to that found on other Louisiana lakes. With one exception, all families of benthic organisms increased while the lake was drawn down. The exact cause of this increase is not apparent. Migration with the receding water levels and subsequent crowding is one hypothesis. This, of course, presupposes a high degree of mobility of the organisms and a lack of effective predation. After the lake was refilled, the benthos in the previously inundated area remained relatively unchanged despite the increased water depth. At the other three stations the benthos density increased notwithstanding the fact that one-half of the samples at each of the stations were taken on previously dry land. Either the benthos survived the three-month dewatered period or they moved rapidly into the reinundated areas. (Authors)

9660. Tatum, Buford L., Jack D. Bayless, Edward G. McCoy, and William B. Smith (North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1966. PRELIMINARY EXPERIMENTS IN THE ARTIFICIAL PROPAGATION OF STRIPED BASS, Roccus saxatilis. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 374-389.

Adult striped bass purchased from commercial fishermen on Albemarle Sound,

N. C., were transported to the Fayetteville and Weldon hatcheries, injected with hormones, and spawned. In addition to ripe fish brought into the Weldon hatchery by fishermen, sexually mature striped bass were obtained from the Roanoke River by electro-fishing gear. These fish, like those from Albemarle Sound, were injected with hormones, held in glass-front plywood aquaria (32" x 24" x 16"), and spawned. Excellent hatches were obtained from these eggs. Laboratory experiments, confirmed by actual practice, indicated that striped bass eggs following six to 28 hours of incubation can be transported up to 12 hours in plastic bags containing water and oxygen with no significant increase in mortality. Attempts to rear fry in aquaria failed although limited success was obtained in outdoor concrete pools. The fry in these pools began taking artificial food 28 days after hatching. Several hundred fry also were reared in earthen ponds. Predation by Chaoborus spp. in these ponds proved especially serious during the sac-fry stage. From various observations, it appeared that rapid changes in pH and/or other chemical characteristics were lethal to fry. The 24-hour TL_m values were determined for Quinaldine, MS-222, salt, and pH using striped bass fingerlings as the test fish. The two-hour TL_m values also were determined. Quinaldine appeared to be superior to MS-222 as a tranquilizer for striped bass. Experiments indicated that no mortality could be attributed to the handling of striped bass fingerlings per se. (Authors)

9661. Sandoz, O'Reilly, and Kenneth H. Johnston. 1966. CULTURE OF STRIPED BASS Roccus saxatilis (Walbaum). Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 390-394.

Prolarvae striped bass Roccus saxatilis (Walbaum) were brought to Oklahoma for experimental rearing in culture ponds. Postlarvae were stocked in ponds which were rich in plankton and later fed 246.5 pounds of prepared foods. Samples were taken periodically for detailed examination indicated that prepared foods were utilized by these fish. The ponds were stocked with adult Tilapia and no small individuals of this species were found at the time of draining. The striped bass harvested after two months with a 15 to 60 percent recovery of the number stocked. (Authors)

9662. Hambric, R. N., and Alan Wenger (Texas Parks and Wildlife Dept., Houston, Texas). 1966. SOCK FILTERS FOR SCREENING FISH. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 397-400.

Several water filters constructed of Saran cloth of different porosities were tested for efficiency in filtering undesirable fish from hatchery pond water supplied. A cloth filter bag, attached to pond water supply pipes, gave promising results. Thirteen ponds tested with these filters were free of wild fish (fish not stocked in test ponds by hatchery personnel) after periods ranging from four to 29 weeks. The remaining four test ponds contained a total of 16 wild fish. Control ponds were heavily infested with wild fish species introduced through the water supply. (Authors)

9663. Hornbeck, Russell G., Warren White, and Fred P. Meyer (Bureau of Sport Fisheries and Wildlife, National Fish Hatchery, Tishomingo, Okla.). 1966. CONTROL OF Apus AND FAIRY SHRIMP IN HATCHERY REARING PONDS. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 401-403.

Single applications of 0.25 ppm Dylox effectively controlled the tadpole shrimp, Apus longicaudatus, and the fairy shrimp, Streptocephalus texanus, in hatchery ponds without adverse effects on bass or channel catfish fry. Bass survival in treated ponds was boosted from 20 to 80 percent by the Dylox treatment. Plankton populations in the treated ponds appeared unaffected. (Authors)

9664. Chastain, G. A., and J. R. Snow (Bureau of Sport Fisheries and Wildlife, Marion, Ala.). 1966. NYLON MATS AS SPAWNING SITES FOR LARGEMOUTH BASS, Micropterus salmoides, Lac. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 405-408.

A commercially available nylon mat material was tested as a spawning site

for largemouth bass. Of 90 mats installed in five ponds during a two-year period, spawns were observed on 68. In the 1965 experiment, 71 percent of the 80 spawns observed in three ponds were on the spawning mats. Three efforts to transfer mats bearing eggs to rearing ponds for incubation and growth were successful to some degree, although acceptable production was obtained in only one of the three trials. In this instance a per-acre production of 37,600 two-inch fingerlings weighing 54.3 pounds was measured. Two attempts at hatching the eggs under controlled conditions followed by transfer to a rearing pond were only partially successful as the fry failed to survive after being hatched successfully in a paddle-wheel hatching trough and a Downing type hatching jar. (Authors)

9665. Mullan, James W., and Richard L. Applegate (Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.). 1966. THE PHYSICAL-CHEMICAL LIMNOLOGY OF A NEW RESERVOIR (BEAVER) AND A FOURTEEN YEAR OLD RESERVOIR (BULL SHOALS) LOCATED ON THE WHITE RIVER, ARKANSAS AND MISSOURI. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 413-421.

This paper compared limnological conditions of two reservoirs in the same drainage to determine whether there is a significant difference in basic fertility associated with age. Bull Shoals, the older reservoir of the study, filled in 1952, contains 45,440 acres at top of power pool, and has been under intensive study since June 1963. Beaver Reservoir, located upstream, began filling in December 1963 and reached 16,210 acres in 1965. At top of the designed power pool, it will encompass 28,220 acres. This new reservoir has been under study since June 1964. All the more commonly assayed physical and chemical parameters, dissolved organic matter content and trace elements, were monitored at designated stations on a year-round basis. Results of these tests through August 1965, proved inconclusive in demonstrating a significantly higher nutrient base in the new reservoir. (Authors)

9666. Peek, Frank. 1966. AGE AND GROWTH OF THE SMALLMOUTH BASS Micropterus dolomieui Lacepede IN ARKANSAS. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 422-431.

The age and growth of the smallmouth bass, Micropterus dolomieui Lacépède, was studied using the scale method. The bass were collected over a three-year period (1962-1964) from 51 locations in 32 streams in three drainages throughout the smallmouth's range in Arkansas and from one location in Missouri. A computer was utilized in determining the mathematical relationship between scale growth and body growth for all specimens used in the study and in comparing the growth of bass collected from the various drainages, streams, and locations in streams. No significant differences in bass growth among the three drainage basins nor among the streams within each basin were detected. Bass growth was found to vary significantly among the various locations within streams indicating that for the bass studied the specific habitat was the important factor influencing growth. A growth summary by location based on the back-calculated lengths of 1,145 smallmouth bass is presented. Age composition is also discussed. (Auth.)

9667. Swingle, Wayne E., Sam L. Spencer, and Thomas M. Scott, Jr. (Alabama Dept. of Conservation, Div. of Game and Fish, Montgomery, Ala.). 1966. STATISTICS ON THE SPORT FISHERY OF THE MOBILE DELTA DURING THE PERIOD OF JULY 1, 1963, TO JUNE 30, 1964. Proc. 19th Ann. Conf. stheast. Ass. Game Commrs. pp. 439-446.

The Mobile Delta was described in this study as the water area in Alabama lying between the Mobile Causeway on the south and Highway 84 bridge on the Tombigbee River near Jackson, Alabama and Choctaw Bluff, Alabama on the Alabama River in Clark County on the north. It consisted of 31,549 acres of water lying in a land area approximately 10 by 60 miles. The delta was divided into seven areas for the creel census. A creel census of the sport fishery was made in the area during July 1, 1963, to June 30, 1964. During this period a total of 49,922 sport fishermen fished the area and caught 294,043 fish weighing 112,325.4 pounds. Each angler spent an average of 4.3 hours to catch 5.9 fish weighing 2.3

pounds or caught 1.4 fish per hour weighing 0.5 pound. At an estimated cost of $3.41 per fishing trip, the value of this sport fishery in the Mobile Delta was $170,234 for one year. The catch per acre was 9.3 fish weighing 3.6 pounds. Fishing pressure was 1.6 fisherman trips per acre. A total of 10 saltwater species, 16 freshwater game species and 15 freshwater non-game species entered the catch. Largemouth bass (Micropterus salmoides), bluegill (Lepomis macrochirus) and redear sunfish (L. microlophus) accounted for 18.6 23.7, and 16.6 percent by weight of the catch, respectively, while the other 38 species accounted for the remaining 41.1 percent. (Authors)

9668. Janssen, Werner A., and Caldwell D. Meyers. 1968. FISH: SEROLOGIC EVIDENCE OF INFECTION WITH HUMAN PATHOGENS. Science, 159(3814): 547-548.

Specific antibodies to several bacteria pathogenic to humans were detected in the serums of white perch from surface waters adjacent to heavily populated areas on Chesapeake Bay. White perch from surface waters adjacent to sparsely populated areas were free of such antibodies. We suggest that fish may become actively infected with human pathogens by exposure to contaminated water and may constitute a hazard to public health. (Authors)

9669. Gutherz, Elmer J. (Bureau of Commercial Fisheries Biological Lab., Brunswick, Ga.). 1967. FIELD GUIDE TO THE FLATFISHES OF THE FAMILY BOTHIDAE IN THE WESTERN NORTH ATLANTIC. U.S. Fish and Wildlife Service Circular 263. 47 p.

Keys are presented to facilitate both field and laboratory identification of the 14 genera and 47 species in the family Bothidae from the western North Atlantic, particularly those south of Cape Hatteras, N. C. Illustrations for all species (except Bothus ellipticus), the salient familial and subfamilial characteristics, and short descriptions with geographic and bathymetric ranges are given. (Auth.)

9670. Averett, Robert C., and F. A. Espinosa, Jr. (Oregon State Game Comm., Corvallis, Oreg.). 1968. SITE SELECTION AND TIME OF SPAWNING BY TWO GROUPS OF KOKANEE IN ODELL LAKE, OREGON. J. Wildlife Mgmt., 32(1): 76-81.

The time and area of spawning of two groups of kokanee (Oncorhynchus nerka) in Odell Lake, Oregon, were observed in the fall of 1965. The first group was from the 1963 hatchery release (Kootenay Lake, British Columbia stock). They spawned from mid-September until early November in the outlet stream, the main tributary, and along one section of the lake shore. The second group, comprised of the natural-reared kokanee of the lake, spawned from early December until mid-January, apparently along only one section of the lake shore. In addition, females of the two groups were significantly different ($P < 0.05$) in mean length and mean weight. The regressions of egg number on fork length showed no significant difference. Reasons for the selection of spawning sites and the origin of the stock of the second group are suggested. (Authors)

9671. Knudsen, George J., and James B. Hale (Wisconsin Conservation Division, Madison, Wisc.). 1968. FOOD HABITS OF OTTERS IN THE GREAT LAKES REGION. J. Wildlife Mgmt., 32(1): 89-93.

Food items were identified in digestive tracts from otters (Lutra canadensis) taken by trappers during February, March, and April over a period of 6 years in Wisconsin, Michigan, and Minnesota. In addition, scats of Wisconsin otters from all seasons of the year were examined for food remains. Fish, particularly non-game fish, were the main prey species. Game fish (including trout) occurred infrequently. Crayfish, frogs, and aquatic insects were other important foods. (Authors)

9672. McDowall, R. M. (Museum of Comparative Zoology, Harvard University, Cambridge, Mass.). 1968. INTERACTIONS OF THE NATIVE AND ALIEN FAUNAS OF NEW ZEALAND AND THE PROBLEM OF FISH INTRODUCTIONS. Trans. Amer. Fish. Soc., 97(1): 1-11.

New Zealand possesses a small and unsaturated but peculiar indigenous freshwater fish fauna. In addition, a considerable variety of introduced species is now in competition with the native species and evidence suggests that this is causing depletion of the native fauna. It is considered that low saturation and high isolation of the New Zealand fauna has produced species with low competitive ability. The largely predatory introduced game fishes are of continental origin and their superior competitive ability is leading to competitive displacement of the native species. (Auth.)

9673. Clemens, Howard P., and Theophilus Inslee (Fisheries Research Center, Dept. of Zoology, Univ. of Oklahoma, Norman, Okla.). 1968. THE PRODUCTION OF UNISEXUAL BROODS BY Tilapia mossambica SEX-REVERSED WITH METHYL TESTOSTERONE. Trans. Amer. Fish. Soc., 97(1): 18-21.

Tilapia mossambica fry were treated for the first 69 days of life with 0, 10, 20, 30, 40, and 50 μg of methyl testosterone per gram of food in order to change the sex of presumptive females to functional males. After treatment, the fish were raised to maturity, the males were bred with normal females, and the offspring of 24 pairs were raised to maturity and sexed. Seven males sired all-female offspring. This strongly indicates that sex direction has been achieved and that the female is the homogametic sex. (Authors)

9674. Beyerle, George B., and John E. Williams (Michigan Dept. of Conservation, Hastings, Mich.). 1968. SOME OBSERVATIONS OF FOOD SELECTIVITY BY NORTHERN PIKE IN AQUARIA. Trans. Amer. Fish. Soc., 97(1): 28-31.

Northern pike confined in tanks and aquaria were presented various species and sizes of food fishes. The optimum size of centrarchids eaten by 7- to 12-inch northern pike was 1.5 inches, and over centrarchids and yellow perch. They showed no choice between centrarchids and yellow perch, but selected centrarchids over bullheads. These results increase doubt as to the effectiveness of northern pike for controlling pan fish populations in lakes, and suggest that large populations of appropriate size soft-rayed food fishes favor good growth of northern pike. (Authors)

9675. Fraser, J. M. (Research Branch, Ontario Dept. of Lands and Forests, Maple, Ontario, Canada). 1968. DIFFERENTIAL RECOVERY OF BROOK TROUT PLANTED BY HAND AND BY AIR DROP. Trans. Amer. Fish. Soc., 97(1): 32-36.

Air dropped brook trout yearlings experienced a lower survival than trout planted by hand. It appears that the mortality is in some manner associated with the air drop since hand planted fish which had been transported by air did not experience this lower survival. (Auth.)

9676. Butler, Robert L., and Vernon M. Hawthorne (Dept. of Zoology, Univ. of California, Berkeley, Calif.). 1968. THE REACTIONS OF DOMINANT TROUT TO CHANGES IN OVERHEAD ARTIFICIAL COVER. Trans. Amer. Fish. Soc., 97(1): 37-41.

A submerged tank at the Sagehen Creek Project of the University of California provides a facility for analysis of trout behavior under natural stream conditions. Here, studies were made to learn to what extent dominant trout will use shade provided by overhead artificial surface cover. Three overhead artificial surface covers of different size were constructed of 3/4-inch plywood. They were mounted on steel legs and painted black on the side in contact with the surface water. During each of three studies, these covers were permuted every two or three days with three different positions in the test area. Three dominant trout representative of the three common trout, brook, rainbow, and brown, were used in three separate tests. Several brook trout and rainbow trout occupied the test area simultaneously with each dominant trout. From 286 hours of observation it was learned that the

rainbow trout showed the lowest use of shade produced by the overhead covers and the highest activity in movements from these shaded areas. Activity of the brown trout was the lowest of the three species, but the use of shade was the highest. The brook trout was intermediate in both these aspects. All three species showed a preference for (Chi-square $P < 0.005$) the shaded areas of the large overhead cover (3 by 3 feet) versus the shaded area provided by the medium-sized overhead cover (2 by 2 feet). Very little utilization was made of the shade provided by the small overhead cover (1 by 1 foot). The rainbow trout showed the least attachment for any particular site, whereas the brook trout and brown trout showed a preference for a particular site and overhead combination. Although these data are limited, they confirm much of what is known by the observant angler. (Authors)

9677. Orcutt, Donald R., Ben R. Pulliam, and Arthur Arp (Bureau of Commercial Fisheries, Boise, Idaho). 1968. CHARACTERISTICS OF STEELHEAD TROUT REDDS IN IDAHO STREAMS. Trans. Amer. Fish. Soc., 97(1): 42-45.

Steelhead spawning behavior and redd construction were studied in 1958 and 1959 in the Clearwater and Salmon River watersheds in Idaho. Steelhead began spawning in early April; spawning peaked between April 20 and May 10 at water temperatures of 36 to 47° F, and was over by June 15. Minimum water depth over a redd was 0.7 feet; maximum water depth exceeded 5 feet. Water velocity 0.4 feet above streambed averaged 2.3 to 2.5 ft/sec. Steelhead favored spawning gravels 0.5 to 4.0 inches in diameter; however, they readily accepted areas with smaller and somewhat larger gravels if 6-inch stones were not abundant. Steelhead tolerated crowding without antagonism; pairs spawned within 4 feet of one another. The average redd occupied 6.5 square yards of gravel, and ranged from 2.9 to 13.4 square yards. (Authors)

9678. Heard, William R., and Louis E. Vogele (Bureau of Sport Fisheries and Wildlife, South Central Reservoir Investigations, Fayetteville, Ark.). 1968. A FLAG TAG FOR UNDERWATER RECOGNITION OF INDIVIDUAL FISH BY DIVERS. Trans. Amer. Fish. Soc., 97(1): 55-57.

9679. Dell, Michael B. (Fisheries Research Inst., Univ. of Washington, Seattle, Wash.). 1968. A NEW FISH TAG AND RAPID, CARTRIDGE-FED APPLICATOR. Trans. Amer. Fish. Soc., 97(1): 57-59.

9680. Patriarche, Mercer H. (Inst. for Fisheries Research, Michigan Dept. of Conservation, Museums Annex, Ann Arbor, Mich.). 1968. RATE OF ESCAPE OF FISH FROM TRAP NETS. Trans. Amer. Fish. Soc., 97(1): 59-61.

9681. Schoumacher, Roger (West Virginia Dept. of Natural Resources, McClintic Wildlife Station, Route 1, Box 125, Point Pleasant, W. Va.). 1968. SOME OBSERVATIONS ON FLATHEAD CATFISH IN THE MISSISSIPPI RIVER BORDERING IOWA. Trans. Amer. Fish. Soc., 97(1): 65-66.

9682. Peterson, Hans H. 1967. THE SEX DISTRIBUTION IN GRILSE IN THE RIVER INDALSALVEN. Swedish Salmon Research Inst. — Report LFI Medd. 15. 3 p.

The salmon catches in many Swedish rivers have shown a very high percentage of grilse during the last years. This increase in grilse has appeared at the same time as the natural smolt production has been reduced and in some rivers completely destroyed and replaced with smolts, produced in rearing stations. The possible connection between those factors is not discussed here. This paper only gives a figure of the sex distribution in the grilse, caught at Bergeforsen in the River Indalsalven during 10 years, 1958-1967. Grilse are counted as all fish smaller than 2.5 kilos. Among these a few small 2-year salmon can appear, particularly among the females. An overwhelming part of the population is males. Only 0.5% are females. Among the females scale-reading has shown that some are small fish with two years in the sea. Sex determination was made by a careful external inspection of every fish, and checked through dissection of a sample number of fish. Sex difference was noted mainly in the shape of the head.

9683. Alexander, Gaylord R., and David S. Shetter. 1967. MORTALITY AND PRODUCTION OF BROOK TROUT AND RAINBOW TROUT PLANTED IN EAST FISH LAKE, MICHIGAN. Michigan Dept. of Conservation Research and Development Report No. 116. 28 p.

Studies on survival, growth, angler exploitation, and production from five consecutive matched plantings of brook trout and rainbow trout (8.5 - 9.5 inches long) in East Fish Lake, Montmorency County, Michigan, 1958-1962 were conducted. The 16-acre lake received 300 of each species each year. Rainbow trout survived at nearly 100% from planting time in October to the following fishing season in April, whereas brook trout averaged only 49%. Most mortality of brook trout occurred between October 15 and the date of ice formation (approximately December 15). Brook trout stayed in shallow water along shore more than did rainbow trout. Loss of trout was attributed to various predators. Of control trout held in wire enclosures, few died. Anglers caught 86% of the rainbow trout which were planted, but only 39% of the brook trout. For each pound of trout planted, anglers caught 3.59 lb. of rainbow trout, but only 0.76 lb. of brook trout. In addition to the five-fold better return on a poundage basis, the rainbow trout provided a fishery throughout the 4-month angling season, whereas nearly all brook trout were caught during the first 10 days. The brook trout grew well, but the rainbow trout did better—up to 1.5 lb. per year. An even greater poundage return on rainbow trout would accrue if the beginning of the angling season were delayed somewhat, to take better advantage of the spring growing season. (Authors)

9684. Anonymous. 1967. SALMON DISEASE IN IRISH RIVERS. Atlantic Salmon J., No. 3. pp. 13-17.

A report prepared by the Fisheries Division of the Department of Agriculture and Fisheries of Ireland in August 1966, as brought up-to-date by further reports issued in April and May 1967.

9685. Carter, Wilfred M., and Joan Heyland. 1967. QUEBEC'S SALMON STATISTICS 1966. Atlantic Salmon J., No. 3. pp. 27-32.

9686. Nicholson, H. Page. 1967. PESTICIDE POLLUTION CONTROL. Science, 158(3803): 871-876.

Suggestions are made for improving the quality of water subject to pollution by pesticides.

9687. Daw, Nigel W. (Thomas C. Jenkins Dept. of Biophysics, Johns Hopkins Univ., Baltimore, Md.). 1967. GOLDFISH RETINA: ORGANIZATION FOR SIMULTANEOUS COLOR CONTRAST. Science, 158(3803): 942-944.

The majority of ganglion cells in the retina of goldfish have receptive fields organized so that the cells respond particularly to simultaneous contrasts of color. The receptive fields are concentrically arranged. If the cell is excited by red light in the center, then it will also be excited by green light in the periphery, and inhibited by green light in the center or red light in the periphery. The occurrence of this arrangement and the reverse is about equal. The receptive field is much larger than had previously been thought. (Auth.)

9688. Weatherholtz, W. M., G. W. Cornwell, R. W. Young, and R. E. Webb (Dept. of Biochemistry and Nutrition and Dept. of Forestry and Wildlife, Virginia Polytechnic Inst., Blacksburg, Va.). 1967. DISTRIBUTION OF HEPTACHLOR RESIDUES IN POND ECOSYSTEMS IN SOUTHWESTERN VIRGINIA. J. agric. Fd. Chem., 15(4): 667-670.

Thirty-five farm pond ecosystems in southwestern Virginia were examined for heptachlor residues. The data showed that every watershed held heptachlor residues, although in amounts less than 300 ppb. The only chlorinated hydrocarbon detected besides heptachlor and its epoxide was DDT. Pond water contained residues only in the spring sampling period, while soil residues decreased during the summer months. Results showed that heptachlor is a persistent insecticide with residues detected up to 25 months after application. (Authors)

9689. Orr, T.S.C. 1967. DISTRIBUTION OF THE PLEROCERCOID OF Ligula intestinalis. J. Zool., Lond. 153(Pt. 1): 91-97.

The geographical distribution of the cestode Ligula intestinalis (Linnaeus 1758) is described with reference to the species of freshwater fish infected. Recent references indicate that the larval stage of this cestode is commonly reported from the Northern Hemisphere but less commonly from the Southern Hemisphere. Cyprinid fish are infected in the Northern Hemisphere in the New and Old World, and where cyprinid fish are scarce, fish occupying a similar ecological position are infected. However, the infection of yellow perch in North America and the absence of infected European perch may suggest that the form in the yellow perch if not morphologically, may be physiologically, distinct. In the Southern Hemisphere cyprinids have been reported as infected in Rhodesia and galaxids as infected in Australia. The infection of galaxids, some of which enter the sea to breed may indicate a possible method of distribution. It is suggested that transplantation of the larval cestode from the body cavity of one fish to another may yield more definite information as regards specificity. The infection of fish, other than those listed, is reviewed with reference to those fish known to occur in habitats where fish infected with Ligula intestinalis also exist. (Auth.)

9690. Sinha, V.R.P., and J.W. Jones. 1967. ON THE AGE AND GROWTH OF THE FRESHWATER EEL (Anguilla anguilla). J. Zool., Lond. 153(Pt. 1): 99-117.

The growth of over 1,000 eels from three different watersheds was investigated. Because of the difficulties of sexing eels we were only able to compare the size of females with that of eels with lobulate organs (some of the latter are potential females). Generally female eels grow faster than the others. There was little difference in the growth of eels with lobulate organs even though there was a great difference in the eel population density in the three localities. But, in any one locality there was a large range of growth. It is suggested that the competition for food is most acute among the smaller size groups. As they grow, eels tend to become cannibalistic and find small eels and elvers an easy source of food. The growth of some continental eels has been related to temperature but this is not confirmed by experimental work. Nevertheless eels eat little or nothing at low temperatures as is shown by the large percentage of eels with empty stomachs in our samples. (Authors)

9691. Sinha, V.R.P., and J.W. Jones. 1967. ON THE FOOD OF THE FRESHWATER EELS AND THEIR FEEDING RELATIONSHIP WITH THE SALMONIDS. J. Zool., Long. 153(Pt. 1): 119-137.

Following the results of the cursory investigations made by Jones & Evans (1960, 1962) into the predatory habits of eels we decided to enlarge on this work. Consequently we looked at the stomach contents of about 5,000 eels. In addition and at the same time, two Welsh streams carrying salmonids were selected and sampled specifically to try to determine the relationship in the feeding habits of eels and salmonids. The food of eels consisted mainly of trichopteran and dipteran larvae and plecopteran and ephemeropteran nymphs, though at times Gastropoda, Annelida, Crustacea and fish were common in the stomachs. Fish was not an important dietary item but, when eaten, the fish most commonly taken were elvers and eels. In the River Dwyfach the salmonids ate more or less the same type of food as the eels, but the trout ate more surface food than the young salmon. The similarity in feeding between the eels and salmonids resulted in apparent competition during the warmer months. In winter when the eels ate little the competition was thus almost negligible. Even though we speak of competition for the food available in the summer months we feel that before this can be accepted as fact we must know the relative abundance of each food organism eaten at this time. (Authors)

9692. Fore, Paul L. (Fisheries Research Lab., Southern Illinois Univ., Carbondale, Ill.). 1966. CUMULATIVE SUBJECT AND AUTHOR INDEX TO THE PROGRESSIVE FISH-CULTURIST, NOS. 1-56, 1934 THROUGH 1941. Bureau of Sport Fisheries and Wildlife, Resource Publication 24. 21 p.

9693. Mansueti, Alice J., and Jerry D. Hardy, Jr. 1967. DEVELOPMENT OF FISHES OF THE CHESAPEAKE BAY REGION: AN ATLAS OF EGG, LARVAL, AND JUVENILE STAGES. PART I. Natural Resources Institute, Univ. of Maryland, College Park. 202 p. Pr. $9.50.

The atlas describes the early life history stages of fishes occurring in tidal fresh, estuarine, and marine waters of New Jersey, Delaware, Maryland and Virginia—an area designated by the authors as "The Chesapeake Bay Region." The Atlas ultimately will include 230 species of fishes. Part I includes the early life history stages of 45 species beginning with the sturgeon and continuing through the catfishes. The exhaustive literature survey from which it was largely developed has resulted in a work that is outstanding and unique in its completeness of text, its wealth of illustrations, and its comprehensive bibliography. New data and drawings of previously undescribed developmental stages supplement the text and contribute significantly to the book as a basic reference.

9694. Groves, Alan B., and Anthony J. Novotny (Bureau of Commercial Fisheries, Biological Lab., Seattle, Wash.). 1965. A THERMAL-MARKING TECHNIQUE FOR JUVENILE SALMONIDS. Trans. Amer. Fish. Soc., 94(4): 386-389.

A simple easily mastered branding technique has been developed which has enabled the placement of a wide variety of easily seen marks on the dorsal skin surfaces of fingerling salmonids. Such marks have been observed for periods up to 18 months. The branding markers used were made from silver and copper metals and are described and illustrated. These were heated only in boiling water. Distinctive marks, which are illustrated, were produced by lightly applying the heated figures for about one and one half seconds to the skin surfaces of anesthetized fingerling salmonids. Localized changes in skin pigmentation at the exact sites of contact faithfully reproduced the configurations of the branding markers. The technique has been used successfully in the laboratory and in the field. (Authors)

9695. Sigler, William F., William T. Helm, Joseph W. Angelovic, D. Wayne Linn, and Susan S. Martin (Dept. of Wildlife Resources, Utah State Univ., Logan, Utah). 1966. THE EFFECTS OF URANIUM MILL WASTES ON STREAM BIOTA. Utah Agricultural Experiment Station Bulletin No. 462. 76 p.

Radium was the radioactive element of primary concern in this study of wastes from uranium mills. Dissolved radium at downstream stations ranged up to as much as several hundred times background and was always significantly above background according to the studies made. There was a substantial population of fish above the uranium mill at Uravan during this study, but between the mill and the confluence of the San Miguel and Dolores Rivers, the fish population had been drastically reduced. Below the confluence, six of the 14 species formerly present were not found during our study. Four other species were reduced in number. Bottom fauna studies in the Animas River in the summer of 1958 showed virtual elimination of life immediately below Durango and severe damage as far downstream as 50 miles. Since that time, abatement measures have diminished pollution enough that bottom fauna are again present immediately below Durango. Our data indicate that water pollution control measures can be effective in reducing the amount and effect of wastes discharged by a uranium mill. A critical problem concerning uranium milling wastes is the large amount of solid ore tailings deposited near streams. These tailings contain most of the radium originally present in the ore and are subject to leaching and erosion. It is extremely important that permanent control measures be taken to stabilize and control these wastes for the continued protection of the water environment. (Authors)

9696. McDowall, R. M. (Museum of Comparative Zoology, Harvard University, Cambridge, Mass.). 1966. A GUIDE TO THE IDENTIFICATION OF NEW ZEALAND FRESH-WATER FISHES. Tuatara, 14(2): 89-104.

9697. Becker, C. D., and W. D. Brunson (Fish. Res. Inst., Univ. of Washington, Seattle, Wash.). 1966. TRANSMISSION OF Diplostomum flexicaudum TO TROUT BY INGESTION OF PRECOCIOUS METACERCARIAE IN MOLLUSCS. J. Parasit., 52(4): 829-830.

9698. Becker, Clarence D. (Fish. Res. Inst., Univ. of Washington, Seattle, Wash.). 1967. Trypanosoma occidentalis SP. N. FROM FRESHWATER TELEOSTS IN WASHINGTON STATE. J. Protozool., 14(1): 153-156.

Trypanosoma occidentalis sp. n., a hemoflagellate encountered in the blood plasma of 3 freshwater teleosts, Cottus gulosus, C. rhotheus (Family Cottidae) and Gasterosteus aculeatus (Family Gasterosteidae) from Washington State, is described and recorded. Morphologic and morphometric features are detailed, and comparisons are made with other trypanosomes reported from North American fishes and from related species of teleosts from Eurasia. The relationship of the geographic isolation of parasite, hosts, and potential vector in the determination of the new species is discussed. (Auth.)

9699. Sterba, Gunther. 1963. AQUARIUM CARE, A COMPREHENSIVE GUIDE. E. P. Dutton & Co., Inc., New York. Translated from the German by Gwynne Vevers. 515 pages.

A revision of the original publication Aquarienkunde (Aquarium Care) to make it complementary to the author's Freshwater Fishes of the World. Part I — Technology; biology and ecology of fishes (200 p.); Part II — Fish diseases (96 p.); and Part III — Aquarium and marsh plants (194 p). The excellent figures and plates add to the usefulness of this translation.

9700. De Santo, Robert S. (Dept. of Biological Sciences, Columbia University, New York, N. Y.). 1967. AN AQUARIUM TIDE TIMER—THEORY AND OPERATION. Ecology, 48(4): 668-670.

The theory, design, and construction of a timing circuit based on three commercially available 24-hour time switches is described. The circuit may be used to control a pumping system to simulate tidal cycles; periodicities up to 47 hours may be programed. The specific use of this device in the cyclical operation of a tide pump for 6 hours 12 minutes, in a cycle of 12 hours 24 minutes, is described and its reliability is outlined. (Auth.)

9701. Hart, I. C. (Water Pollution Research Lab., Stevenage, England). 1967. NOMOGRAMS TO CALCULATE DISSOLVED-OXYGEN CONTENTS AND EXCHANGE (MASS-TRANSFER) COEFFICIENTS. Water Research, 1(6): 391-395.

Nomograms have been constructed for the calculation of dissolved-oxygen contents in water, employing the oxygen saturation values of Montgomery et al. (1964), and for the calculation of expected exchange (mass-transfer) coefficients in streams from their mean velocities and depths. (Auth.)

9702. Saunders, Richard L., and John B. Sprague (Fisheries Research Board of Canada, Biological Station, St. Andrews, N. B., Canada). 1967. EFFECTS OF COPPER-ZINC MINING POLLUTION ON A SPAWNING MIGRATION OF ATLANTIC SALMON. Water Research, 1(6): 419-432.

Pollution from a base metal mine on a tributary of the Northwest Miramichi River caused many adult Atlantic salmon, which were on their normal upstream spawning migration, to return prematurely downstream through a counting fence on that river during summer and early autumn. These observations gave an opportunity to document avoidance reactions of salmon to pollution, which has seldom been done in the fishes' natural environment. Downstream returns of salmon rose from between 1 and 3 percent during 6 years before pollution to between 10 and 22 percent during 4 years of pollution. Early runs (June-July) of salmon to the headwaters were delayed and reduced in number. Chemical analyses of river water showed levels of Cu^{2+} and Zn^{2+} which varied with rates of river discharge. During some periods Cu^{2+} + Zn^{2+} concentrations exceeded lethal levels for immature salmon, as established in another (laboratory) study. The threshold concentration for 50 percent survival of fish under specified temperature conditions is designated as 1·0 toxic unit. Adult salmon in nature showed avoidance reactions at about 0.35-0.43 toxic unit of Cu^{2+} + Zn^{2+}. A level of 0.8 toxic unit may have blocked all upstream movement. Of the salmon returning downstream because of pollution, about 31 percent reascended, 62 percent were not seen again

and 7 percent were taken by angling and commercial fishing below the counting fence. Estimated losses from the stock available in the upper part of the river from 1960 to 1963 varied from 8 to 15 percent of the total run. There is no evidence that successive year-classes of salmon are growing accustomed to the pollution. (Authors)

9703. Ghittino, P., A. Provana, and M. L. Codegone. 1967. EXPERIMENTAL DIETARY HEPATOMA IN RAINBOW TROUT. THE ROLE OF COTTONSEED MEALS AND OTHER DIETS. Il Cancro - Periodico dell'Istituto di Oncologia di Torino, Anno XX, N. 6. 24 p.

Aflatoxin-free cottonseed meals were not able to induce hepatomas in trout continuously exposed for 12-24 months. On the contrary, cottonseed meal-free diets, which contained peanut meal contaminated with aflatoxin (360 ppb of aflatoxin B_1 and trace of B_2), induced hepatomas in 4 months, at water temperature of 15° C, and in 8 months at water temperature of 8° - 9° C. Another diet containing no peanut- and no cottonseed-meals, which was aflatoxin negative at the manufacturing time but which became positive during the storage, also induced hepatomas in trout. Other diets which contained no aflatoxin did not produce tumors. The role of aflatoxin in the induction of liver tumors in trout is confirmed. On the basis of the present results, it appears that when the aflatoxin level in the diet is relatively low the tumor incidence is not modified but tumor onset is delayed. Hepatomas appeared with a comparable incidence in trout previously known to be hepatoma susceptible, and trout supposed to be resistant; according to this study, the species Salmo gairdneri appears to be susceptible to hepatoma, and no strain factors should be clearly involved. Histopathological examination of trout liver showed hepatomas only in trout fed diets containing aflatoxin. They were preceded by peculiar "aflatoxicosis or damage-cells" and by "regenerating-cells". The precocious or early hepatomas, similar to regenerative or hyperplastic nodules are to be generally considered as having a true neoplastic nature. In fact, after the onset of such micro-nodules, a group of trout was fed with a non carcenogenic diet, and trout developed hepatomas. Cholangitis was found in all groups of experimental trout. This lesion later appears to evolve in a sclerosis and to be associated with a proliferation of "oval-cells". The authors suggest that many factors may be involved in such inflammatory change, but concerning the cottonseed products, Sterculia foetida oil (containing 55% Cyclopropenes), can be considered as the principal cause, being able to produce marked cholangitis in 100% of trout so exposed for 2-3 months. (Authors)

9704. Baldwin, Norman L., Raymond E. Millemann, and Stuart E. Knapp (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oreg.). 1967. "SALMON POISONING" DISEASE. III. EFFECT OF EXPERIMENTAL Nanophyetus salmincola INFECTION ON THE FISH HOST. J. Parasit., 53(3): 556-564.

The effect of experimental infection with the "salmon poisoning" fluke, Nanophyetus salmincola, on five species, including three subspecies, of salmonid fish was studied. The estimated numbers of cercariae that killed 50% of kokanee (Oncorhynchus nerka), Montana black-spotted cutthroat trout (Salmo clarki lewisi), Atlantic salmon (S. salar), coho salmon (O. kisutch), rainbow trout (S. gairdneri), and coastal cutthroat trout (S. clarki clarki), all between 30 and 37 mm in fork length, in 24 hours, were 58, 74, 110, 200, 295, and 430, respectively. This range in sensitivity of the different species of fish to the parasite was correlated with the natural duration of the host-parasite relationships. The symptomatic, gross, and histopathologic changes associated with penetration and migration of N. salmincola cercariae in the above trout and salmon species and in Lahontan cutthroat trout (S. clarki henshawi) are described. Penetration and migration of cercariae in fish were studied. Parasites were found inside fin rays and blood vessels, and were present in internal organs within 1 hour after epidermal penetration. (Authors)

9705. Crane, J. W., and J. D. Mizelle (Sacramento State College, Sacramento, Calif.). 1967. STUDIES ON MONOGENETIC TREMATODES. XXXI. FIVE NEW SPECIES OF Gyrodactylus FROM CALIFORNIA FISHES. J. Parasit., 53(2): 270-273.

The following new species are described from California fishes: Gyrodactylus armatus from Leptocottus armatus Girard, Pacific Ocean, Bodega Bay, Sonoma Co.; G. brevis from Salmo gairdneri Richardson (type host) and Hesperoleucas navarroensis Snyder, Navarro River, Mendocino Co.; G. navarroensis from Hesperoleucas navarroensis Snyder, Navarro River, Mendocino Co.; G. sculpinus from Leptocottus armatus Girard, Pacific Ocean, Bodega Bay, Sonoma Co.; and G. stellatus from Platichthys stellatus (Pallas), Pacific Ocean, Bodega Bay, Sonoma Co. (Authors)

9706. Schaefer, Richard H. 1967. SPECIES COMPOSITION, SIZE AND SEASONAL ABUNDANCE OF FISH IN THE SURF WATERS OF LONG ISLAND. N. Y. Fish Game J., 14(1): 1-46.

A total of 67,918 fish representing 71 species were collected from the ocean surf at Fire Island, New York, between July 1 and November 30 in 1961, between May 1 and October 31 in 1962, and between May 1 and November 30 in 1963. This catch resulted from 188 sets of a 1,300-foot haul seine operated on 111 dates during the study period. The species composition of the catch each year, as well as size ranges and mean lengths for each species, are reported by month. The most abundant species (those which constituted 1 percent or more of the total catch in any one year) are discussed individually, and monthly length-frequency distributions for each are presented. (Auth.)

9707. Perlmutter, Alfred, Eugene E. Schmidt, and Eugene Leff. 1967. DISTRIBUTION AND ABUNDANCE OF FISH ALONG THE SHORES OF THE LOWER HUDSON RIVER DURING THE SUMMER OF 1965. N. Y. Fish Game J., 14(1): 47-75.

On the premise that young-of-the-year fish, which frequent shallow-water areas, would be better indicators of annual fluctuations in pollution than older fish, seining operations were carried on at nine stations along the shore of the lower Hudson River during the summer of 1965. Each station was visited five times in the period from June 21 through August 16. Most common in the catch were the spottail shiner, freshwater killifish, white perch, saltwater killifish, common silverside, Johnny darter, blueback herring, shad, alewife, bay anchovy, white mullet, tidewater silverside, goldfish, carp, golden shiner, common sunfish, striped bass and American eel. The specimens taken were preponderantly young of the year. Population composition in the euryhaline environment south of Poughkeepsie was compared with that in the fresh water area upstream. The levels of abundance recorded should serve as standards for comparison in subsequent years. (Authors)

9708. Forney, John L. 1967. ESTIMATES OF BIOMASS AND MORTALITY RATES IN A WALLEYE POPULATION. N. Y. Fish Game J., 14(2): 176-192.

The population of walleyes in Oneida Lake was estimated from fish marked on the spawning grounds and recaptured during the summer and fall following their dispersal. Numbers of age IV and older walleyes in April ranged from 265,700 to 1,035,000, and the estimated standing crop of age III and older fish varied from 16.5 to 27.3 pounds per acre between 1957 and 1963. Annual survival was determined from recoveries of fish marked in successive years on the spawning grounds, and estimates of the sport fishing catch during three seasons provided data needed to separate fishing and natural mortality. The highest annual mortality rate occurred in 1959 when anglers harvested about half the spring population. In other years rates of total mortality were 0.11 to 0.40. Loss of adult fish from natural causes was about 5 percent per year. (Auth.)

9709. Kelly, William H. 1967. RELATION OF FISH GROWTH TO THE DURABILITY OF TWO DYES IN JAW-INJECTED TROUT. N. Y. Fish Game J., 14(2): 199-205.

National Fast Blue 8GXM and hydrated chromium oxide were jaw-injected into brook trout and brown trout. Permanence of the dye marks was dependent on growth rate and independent of time. National Fast Blue 8GXM was permanent on all trout whenever gain in weight did not exceed 200 percent. In some cases, fading and eventual extinction accompanied greater gains in weight, but in one field test clearly visible marks were retained on brook trout for which weight gains averaged 375 percent. Hydrated chromium oxide was more variable, and extinction occurred when weight gain was between 63 and 277 percent. However, one trout possessed a good quality mark after gaining 650 percent in weight, and in another test well defined concealed marks were found. In the light of this evidence, hydrated chromium oxide seems the best prospect for a lifetime mark in trout. National Fast Blue 8GXM will persist for more than 2 years if growth is not excessive. (Auth.)

9710. Kelly, William H. 1967. MARKING SMALL TROUT BY CHEEK PAD INJECTION. N. Y. Fish Game J., 14(2): 206-208.

Cheek pad injection with National Fast Blue 8GXM provides one of the most durable externally visible marks for the early-life stages of trout currently available. Considering that most of the fish used in this study were less than 2 inches long and that other methods of marking extremely small fish often have greater disadvantages, this seems to be a practical method of marking such fish, but its applicability is currently limited by rather high post-marking mortality.

9711. Allen, Norris, and Michael J. Pelczar, Jr. (Dept. of Microbiology, Univ. of Maryland, College Park, Md.). 1967. BACTERIOLOGICAL STUDIES ON THE WHITE PERCH, Roccus americanus. Chesapeake Sci., 8(3): 135-154.

A total of 169 bacterial cultures were isolated from the internal organs of healthy white perch (Roccus americanus), and were characterized by the method of numerical taxonomy. These cultures sorted into 7 major groups and were identified as representing Bacillus, Achromobacter, Pseudomonas, Aeromonas, Enterobacter, and Micrococcus. The pasteurella-like bacteria implicated in the 1963 massive fish kill were included in the analysis. None of the cultures representing the normal flora of white perch showed any significant similarity with these organisms. The pasteurella-like bacteria were found capable of causing infection and death when inoculated intra-peritoneally in white perch. An inoculum size of approximately 10^7 cells was required to kill 50% of the inoculated hosts. Several other bacterial species isolated from healthy white perch also caused infection and death when a similarly large inoculum was used. (Authors)

9712. Jolly, V. Hilary (Water Board, Sydney, Australia). 1967. OBSERVATIONS ON THE SMELT Retropinna lacustris Stokell. N. Z. J. Sci., 10(1): 330-355.

A study was made of the smelt Retropinna lacustris in two New Zealand lakes; Lake Rotorua, the type locality of the species, and Lake Taupo, where smelt were first introduced in 1936 to serve as food for trout. Some observations on growth were also made on smelt held in hatchery ponds. Eggs collected from beach sand and hatched in a field laboratory provide some information on embryological development. Smelt were caught in the open waters by tow-nets, and from around the shores by seine net. Spawning extends from spring to autumn, and the demersal eggs are deposited in shallow water on sandy beaches or in slack water at stream mouths. The eggs hatch in 8-10 days depending on the temperature. the larval fish are approximately 2mm in length on emergence, and are planktonic. Juvenile fish from about 15-30 mm are widely dispersed in the lakes and feed almost exclusively on planktonic crustacea, with the addition of some algae. At about a length of 30 mm the young smelt join shoals of larger fish feeding inshore. The food of the shoaling fish was found to be very varied, but to consist mainly of insects (larval and adult stages) and of Entomostraca. Some comparative data on growth rates are given. It was found that the mean size of ripe fish in Rotorua

exceeded that of Taupo, as did the maximum size (Rotorua 65 mm, Taupo 60 mm), while fish held in ponds attained a size of 88 mm. Four parasites were found: Saprolegnia, glochidia larvae, fluke metacercaria causing "Black Spot", and the cystercercoid stage of a cestode in the alimentary tract. (Auth.)

9713. Frassetto, R. 1967. A NEUTRALLY-BUOYANT, CONTINUOUSLY SELF-RECORDING OCEAN CURRENT METER FOR USE IN COMPACT, DEEP-MOORED SYSTEMS. Deep-Sea Research, 14(2): 145-157.

A continuously self-recording current meter for deep ocean measurements has been developed and tested. It has near-neutral buoyancy, is of small size for use on miniaturized subsurface moored systems and mostly made of components that are readily available. The main features are its utmost simplicity, its low cost, and its reliability. Recording is made on a miniature chart recorder capable of running for over two months. Noise on the records, principally originated by mooring line motions is filtered visually during the data-reduction phase. Data are digitalized by semi-automatic methods before being fed to an electronic computer for analysis. (Auth.)

9714. Kesteven, G. L. 1966. QUANTITATIVE METHODS IN THE STUDY OF PROCESSES IN MARINE POPULATIONS. Proc. ecol. Soc. Aust. 1:65-74, 4 refs; CSIRO Absts., 14(10): Abst. No. 1049.

Some models which have been constructed to represent quantitatively the relations between various processes in fish populations are discussed. Some characteristics of marine situations, and some practical difficulties of research on them are discussed. These characteristics and difficulties underline the need for improved knowledge of the determinants of local and general patterns of distribution. Animal aggregations in marine situations, the extent to which these might be expressive of social forces, the nature of social forces in these populations and the role they might play in determining the character and rate of population processes are discussed.

9715. Gibson, R. N. 1967. THE USE OF THE ANAESTHETIC QUINALDINE IN FISH ECOLOGY. J. Anim. Ecol., 36(2): 295-301.

The properties of the anaesthetic quinaldine were investigated in order to assess its suitability for capturing fish from rock pools. The minimum exposure times for complete anaesthesia at concentrations of 20, 10, 5 and 2.5 ppm were determined for five species of littoral fish. The required time for anaesthesia varies from 0.75-2.7 minutes at 20 ppm to 3.2-9.0 minutes at 5.0 ppm. It was found that a concentration of 2.5 ppm was insufficient to induce the required depth of anaesthesia in all the species tested. Long exposures (2 and 5 hours cause some mortality in Acanthocottus bubalis and Pholis gunnellus at 20 and 15 ppm. Recovery is rapid after anaesthesia, varying from 2 to 25 minutes depending on the concentration and the species. The recovery time after long exposures is slightly greater. The influence of quinaldine on behaviour is briefly described. Its mode of action is considered to be analogous to that of barbiturates. Quinaldine was tested on the shore at concentrations of 5-10 ppm and was found to facilitate the capture of fish from rock pools. It is suggested that this drug could be of great value in obtaining fish from such habitats for short or long-term ecological studies. (Auth. summ.)

9716. Wood, Carl E. (Dept. of Wildlife Science, Texas A&M Univ., College Station, Texas). 1967. PHYSIOECOLOGY OF THE GRASS SHRIMP, Palaemonetes pugio, IN THE GALVESTON BAY ESTUARINE SYSTEM. Contr. Mar. Sci., 12: 54-79.

The seasonal distribution, growth rate, and reproductive potential of the grass shrimp, Palaemonetes pugio, as affected by temperature and salinity were studied in the Galveston Bay estuarine system, by means of a field survey of 13 stations from March 1963 to February 1964 and a controlled laboratory experiment. Grass shrimp appeared throughout the year with greatest abundance in July and October. Abundance was greatest in waters of 10-20 ppt salinity and least in <1.0 ppt salinity.

The abundance of the sexes (males, ovigerous females, and non-ovigerous females) of grass shrimp is related to temperature with the sex ratio (male to all females) approximately 1:1. Growth to maturity (20-24 mm) takes two to three months during June-September and four to six months during the remainder of the year. No appreciable increase in length or weight could be attributed to salinity. Greatest increase in length and weight attributed to temperature occurred in waters of ≥30° C and least in waters of 11° C to 14° C. There is a size difference between males (23.5 mm), non-ovigerous females (26.2 mm), and ovigerous females (30.0 mm). Longevity of grass shrimp is about one year. P. pugio can survive over a wide range of salinities and temperatures with best survival in waters of 4-16 ppt salinity and 18° C to 25° C. Ovigerous females were collected from March to October with two peak spawning seasons, one in early summer (July) and the other in early fall (October). Water temperatures of approximately 18-20° C are required for reproduction to occur. The largest females (28-42 mm) produce egg masses in the first spawning peak with gradual replacement by smaller individuals in the second peak. The number of eggs carried by ovigerous females increased in a geometric progression related to length. Number of eggs in an egg mass is a linear function of the female's length. (Auth.)

9717. Schlicht, Frank G., and William N. McFarland (Dept. of Biology, Texas A & M Univ., College Station, Texas). 1967. INCIDENCE OF TRYPANORHYNCHAN PLEROCERCOIDS IN SOME TEXAS COAST SCIAENID FISHES. Contr. Mar. Sci., 12: 101-112.

The incidence and the degree of infestation with trypanorhynchan plerocercus larvae in sciaenid fishes from south Texas coastal waters was determined during the summer of 1958. Plerocerci were found in all estuarine sciaenids, but more stenohaline species examined from the Gulf of Mexico were not infested. Among infested species a high incidence was found in Bairdiella chrysura (44.6%) and in Cynoscion nebulosus (32%). The larvae were primarily Poecilancistrium caryophyllum. The plerocercus stage of Diplootobothrium springeri, from the black drum, Pogonias cromis, is reported for the first time. An unidentified species of Pterobothrium was found in Menticirrhus americanus. Infestation relates to age of fish and, presumably, to a change in diet that introduces an appropriate vector harboring the procerci. (Authors)

9718. Wilson, William B. (Marine Laboratory, Texas A & M Univ., Galveston, Texas). 1967. FORMS OF THE DINOFLAGELLATE Gymnodinium breve Davis IN CULTURES. Contr. Mar. Sci., 12: 120-134.

Morphological features of forms of the marine dinoflagellate Gymnodinium breve that were observed in cultures are described. Most forms are illustrated with photographs. Culture conditions at the times that various forms were observed are given. The most common encystment stage is described and compared with other forms. General features of cell division and other possible reproduction stages are illustrated and discussed. Forms resulting from variations in physical factors and reproductive stages are discussed. (Auth.)

9719. Steed, David L., and B. J. Copeland (Univ. of Texas Marine Science Inst. at Port Aransas, Texas). 1967. METABOLIC RESPONSES OF SOME ESTUARINE ORGANISMS TO AN INDUSTRIAL EFFLUENT. Contr. Mar. Sci., 12: 143-159.

The oxygen consumption rates of several species of estuarine organisms were measured in various concentrations of a petrochemical company effluent. Test solutions used were of concentrations less than the TL_m value, as determined by the toxicity bioassay method. It was learned that both short-term and chronic exposure exert stress conditions causing organisms to experience changes in metabolic requirements. A typical response was a decreased metabolic rate in low concentrations and an increased rate upon prolonged exposure or in concentrations approaching the TL_m value. However, responses may vary with the type effluent used, length of exposure and with the particular species under study. These data were interpreted with respect to the ecological requirements of individual organisms and entire populations. It is apparent that populations may experience gross deleterious effects, without apparant "fish kills", under what may normally be interpreted to be "safe" pollution levels. (Authors)

9720. Wohlschlag, Donald E., and James N. Cameron (Univ. of Texas Marine Science Inst. at Port Aransas, Texas). 1967. ASSESSMENT OF A LOW LEVEL STRESS ON THE RESPIRATORY METABOLISM OF THE PINFISH (Lagodon rhomboides). Contr. Mar. Sci., 12: 160-171.

Respiratory metabolism of the pinfish was determined by measuring oxygen consumption in an enclosed plastic chamber that could be rotated. By means of multiple regression equations the observed oxygen consumption rates were related to body weights, temperatures, and swimming velocities for fish acclimated in both unpolluted and slightly polluted waters over the temperature ranges of 10-20° and 20-30° C and at the single temperature of 20° C. Waters were kept at relatively high levels of dissolved oxygen. Under normal conditions the pinfish seems to have quite high rates of oxygen consumption compared to temperature species. In all cases the slightly polluted water caused a depression of respiratory levels. There was the lowest degree of depression at or near 20° C. For small fish the response to temperature was nearly linear from 10-30° C; depression of respiration was relatively uniform for both resting fish and fish swimming at 10 m/min. For larger fish at 10° C, there was a pronounced depression of respiration in polluted waters, especially for swimming fishes; at 30° C the depression was marked for both swimming and resting fish. For larger swimming fish, the possibility of metabolic loading is discussed at both the 10° C and 30° C levels. Statistically, the greatest variability in oxygen consumption rates occurs at the lowest temperatures, and least at 20° C. The swimming-oxygen consumption rate coefficients are highest for the lower temperature ranges. The great metabolic depression due to stress on larger fishes at low temperatures is discussed in terms of winter kills that tend to affect larger fish most severely. The possible effects of thermal "pollution", whereby the winter temperatures could be raised artificially, is appraised in terms of relatively high maintenance requirements under stresses of high and low temperatures in the presence of stresses like those induced by pollution. The results of slow growth rates on population dynamics are also evaluated in terms of adverse survival rates. (Authors)

9721. Reed, Edward B., and George Bear (Zoology Dept., Colorado State Univ., Ft. Collins, Colo.). 1966. BENTHIC ANIMALS AND FOODS EATEN BY BROOK TROUT IN ARCHULETA CREEK, COLORADO. Hydrobiologia, 27(1-2): 227-237.

On each of four dates in summer 1961, approximately 100 brook trout (Salvelinus fontinalis) were taken by flyrod from Archuleta Creek, a small mountain stream in south-central Colorado. Simultaneously benthic animals were sampled with a Surber sampler at three stations. Four habitats were sampled at each station. The riffle habitat yielded the greatest weight of bottom organisms, 50.05 grams (about 3 to 4 times as much as the head- and foot-pool areas respectively); mid-pools were the poorest habitat in weight of organisms, 3.89 grams. Approximately three fourths of the trout stomachs contained terrestrial insects which composed about 45% of the volume of the stomach contents. Thus nearly one half of the trout's support came from outside the aquatic ecosystem. (Auth. summ.)

9722. Khan, Jamil A., and A. Quajjum (Dept. of Zoology, Aligarh Muslim Univ., Aligarh (U.P.), India). 1966. ON THE IONIC COMPOSITION OF FIVE TROPICAL FISH-PONDS OF ALIGARH (U.P.), INDIA. Hydrobiologia, 28(2): 195-202.

The ionic composition of four very productive and one unproductive fishpond has been investigated. The concentration of various ions is typical of carbonate waters except in two ponds for reasons of pollution. Calcium and bicarbonate are the major cation and anion while inspite of high productivity potassium is not very abundant. Because of the geographical position the area enjoys, the carbonate content seems to be important in productivity evaluation. For the same, its equivalent ratio is calcium and bicarbonate is very significant. (Auth. summ.).

9723. Kocurova, Eva. 1966. THE APPLICATION OF THE ALGICIDE CA 350 IN THE LUBI RESERVOIR NEAR TŘEBIČ, CZECHOSLOVAKIA. Hydrobiologia, 28(2): 223-240.

In 1964 two applications of the algicide CA 350 were made on the reservoir

Lubi near Trebic in order to remove a blue-green algae water blooming. The first use of the algicide was made in May. Blue-green algae disappeared during 24 hours and no marked changes occurred of other biological and chemical characteristics in the reservoir water. Two weeks following the control heavy development of green algae was noted to occur in the reservoir, but it ceased in a short interval having no bad effects on the raw water quality. In the beginning of July, about 6 weeks following the first application, Hydrodictyon reticulatum, a green alga, developed in the lower part of the reservoir in such an amount that it must be removed mechanically. This development was probably raised by the deteriorated water quality in the inflowing stream and due to the omission of the suggested preventive measures. Another water bloom appeared in the beginning of August and the algicide was applied again with similar effects. This report confirms the results gained by the workers of the Institute of Hygiene, Prague, on the Sedlice reservoir, and by SVEC, who experimented on the Frystak reservoir in 1959: The algicide CA 350 acts immediately against blue-green algae without any side toxic effects produced by copper. (Auth. summ.)

9724. Costa, H. H. (Dept. of Zoology, Univ. of Ceylon, Peradeniya, Ceylon). 1966. THE EFFECT OF EXERCISE ON THE SURVIVAL OF Phoxinus phoxinus L. IN SODIUM CYANIDE SOLUTIONS. Hydrobiologia, 28(2): 241-251.

Minnows (Phoxinus phoxinus) exercised moderately or severely in an apparatus lost their sense of balance in a shorter time than controls in moderately low and high concentrations of sodium cyanide. This loss of equilibrium was also proportional to the duration of exercise. (Auth. summ.)

9725. Hill, David W., and Perry L. McCarty (Federal Water Pollution Control Admin., Southeast Water Lab., Athens, Ga.). 1967. ANAEROBIC DEGRADATION OF SELECTED CHLORINATED HYDROCARBON PESTICIDES. J. Wat. Poll. Contr. Fed., 39(8): 1259-1277.

Degradation of most of the chlorinated hydrocarbon pesticides studied was more rapid under anaerobic than under corresponding aerobic conditions. The pesticides studied and their extractable degradation products can be ranked in the following approximate order of increasing persistence under anaerobic conditions: lindane, heptachlor, endrin, DDT, DDD, aldrin, heptachlor epoxide, and dieldrin. The anaerobic degradation of lindane was increased greatly with increased biological activity and was generally more rapid in anaerobic than in corresponding aerobic environments. DDT converted very rapidly to DDD under anaerobic conditions, but under aerobic conditions of several milligrams per liter of dissolved oxygen it persisted as DDT. Under anaerobic conditions heptachlor converted quickly to extractable degradation products which were more persistent than the initial heptachlor. Endrin also formed extractable degradation products under anaerobic conditions. The increase of temperature from 20° to 35° C produced no significant increases in pesticide degradation rates except for the anaerobic degradation of lindane and the aerobic degradation of DDT. The chlorinated hydrocarbon pesticides were more strongly sorbed by algae than by bentonite clay. The adsorption of the chlorinated hydrocarbon pesticides was inversely related to their solubilities.

9726. English, T. Saunders (Dept. of Oceanography, Univ. of Washington, Seattle, Wash.). 1967. PRELIMINARY ASSESSMENT OF THE ENGLISH SOLE IN PORT GARDNER, WASHINGTON. J. Wat. Poll. Contr. Fed., 39(8): 1337-1350.

The multiple use of Port Gardner for receiving pulp and paper mill effluents and commercial trawling for English sole does not appear to be harmful to the fishery. The shallow area near the deep-diffuser outfall appears to be a source of young English sole recruited to an increasingly productive commercial stock. Further studies of the life history of the English sole in Port Gardner are planned. Unless some unexpected discontinuity becomes apparent, the complete life cycle of the English sole seems to be represented in Port Gardner.

9727. Keup, L. E., W. M. Ingram, and K. M. Mackenthun (R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio). 1966. THE ROLE OF BOTTOM-DWELLING MACROFAUNA IN WATER POLLUTION INVESTIGATIONS. U. S. Public Health Service Publ. No. 999-WP-38. 23 p.

The authors evaluate the use of bottom-dwelling animals in water pollution abatement programs. How and why the bottom-dwelling fauna exhibit pollution-induced changes and the factors involved in data collection, interpretation, and evaluation are discussed. A bibliography on the theory and applied use of bottom-dwelling animals in pollution evaluation is included. (Authors)

9728. Salo, Ernest O., and William H. Massmann (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1967. THE ECOLOGICAL CONSEQUENCES OF PESTICIDE RESISTANCE IN FISHES. Trans. 32nd N. Amer. Wildl. Conf. pp. 103-107.

Resistance to pesticides is genetically based. Progeny of resistant fishes show no decrease in level of resistance when reared for four generations in the absence of insecticides. Rare individuals among susceptible populations exhibit resistance, and presumably provide the genetic material for selection to act upon. Artificial selection through exposing consecutive generations of mosquitofish to lethal levels of toxicants has resulted in strains showing increased tolerances. This suggests that, although resistance is now geographically limited, the ingredients for its spread are operative, i. e., time, continued use of pesticides, and exposed populations.

9729. Walford, Lionel (Bureau of Sport Fisheries and Wildlife, Sandy Hook Marine Lab., Highlands, N. J.). 1967. PROBLEMS OF CONSERVATION IN THE ATLANTIC ESTUARINE ZONE. Trans. 32nd N. Amer. Wildl. Conf. pp. 161-164.

9730. DeWilde, Mary Anne, and A. H. Houston (Dept. of Biology, Marquette Univ., Milwaukee, Wisc.). 1967. HEMATOLOGICAL ASPECTS OF THE THERMOACCLIMATORY PROCESS IN THE RAINBOW TROUT, Salmo gairdneri. J. Fish. Res. Bd. Canada, 24(11): 2267-2281.

The blood oxygen-capacity of the rainbow trout has been investigated as a function of thermal acclimation in terms of erythrocyte abundance, packed cell volume, hemoglobin concentrations, and mean erythrocytic volume and hemoglobin content. Fish at the lower acclimation temperatures employed (3, 7° C) were characterized by relatively low erythrocyte counts, hematocrits, and hemoglobin levels. Mean erythrocyte volumes tended to be relatively high, whereas mean erythrocytic hemoglobin content was somewhat below that typical of the higher temperature groups. In general, animals held at intermediate temperatures (11, 14, 17° C) showed significant increases in oxygen-carrying capacity by comparison with cold-acclimated fish. Finally trout at 21° C typically had larger numbers of somewhat smaller red cells, more hemoglobin, and higher levels of hemoglobin per erythrocyte than either the low- or intermediate-temperature fish. Significant differences were observed between summer and fall-winter series of trout, particularly with respect to hemoglobin levels. The results are discussed in relation to the general problem of respiratory thermoadaptation. (Authors)

9731. Buerkle, Udo (Fisheries Research Board of Canada, Biological Station, St. Andrews, N. B., Canada). 1967. AN AUDIOGRAM OF THE ATLANTIC COD, Gadus morhua L. J. Fish. Res. Bd. Canada, 24(11): 2309-2319.

Auditory thresholds were determined by means of a conditioned response to sound stimuli at frequencies 17.6, 35.3, 70.7, 141, 283, and 400 cycles/sec for 10 cod, Gadus morhua. The conditioned response was a change of cardiac rhythm. It was established through an electric shock as unconditioned stimulus, and could be monitored on an oscilloscope. The thresholds indicated cod to have high sensitivity to sounds up to 283 cycles/sec. At 400 cycles/sec they were relatively deaf. Background noise in the experimental tank was high enough to influence thresholds; an absolute threshold could therefore not be determined. (Auth.)

9732. Healey, M. C. (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1967. ORIENTATION OF PINK SALMON (Oncorhynchus gorbuscha) DURING EARLY MARINE MIGRATION FROM BELLA COOLA RIVER SYSTEM. J. Fish. Res. Bd. Canada, 24(11): 2321-2338.

During May and June 1966, the migration of pink salmon fry from the Bella Coola River was studied in Burke Channel, British Columbia. The movement of pink fry down Burke Channel was saltatory. Short periods of active migration were interspersed with longer periods when the fry did not migrate and accumulated in bays. Fry were sampled from these accumulations and their ability to orient using celestial cues was examined. During the early morning, fry tended to prefer directions at right angles to their direction of migration, but at other times of the day preferred the direction of migration. The preference for the direction of migration was strongest at midday. Fry were better oriented on clear days than on cloudy days. These data indicate that fry may use celestial cues to find directions during their oceanic migrations. (Auth.)

9733. Ursin, Erik (Danish Inst. for Fishery and Marine Research, Charlottenlund, Denmark). 1967. A MATHEMATICAL MODEL OF SOME ASPECTS OF FISH GROWTH, RESPIRATION, AND MORTALITY. J. Fish. Res. Bd. Canada, 24(11): 2355-2453.

A simple metabolic model describing growth as the difference between what enters the body and what leaves it, is elaborated assuming that synthetic processes (the building-up, the anabolism) are consuming energy supplied by processes of decomposition (the break-down, the catabolism). This leads to partitioning total catabolism into two components, one being a function of the rate of synthesis, another keeping the body functioning independently of synthesis. The rate of synthesis is described as a function of food taken, of the efficiencies of digestion and energy conversion, and of the absorbing surface of the intestine. Catabolic processes are supposed to be functions of the oxygen concentration in the water, the absorbing surface of the gills, and the rate of oxygen transport. Both kinds of processes are made functions of temperature in the way enzymatic processes usually are. Assuming that molecular interactions accidentally go wrong makes natural mortality, like growth, a function of the rates of anabolic and catabolic processes and body size. Application of the model to data of length-at-age, food and oxygen consumption, weight loss, gill area, and natural mortality indicates that at least some of the main hypotheses cannot be rejected on available evidence. (Auth.)

9734. Anderson, R. Stewart (Canadian Wildlife Service, c/o Biology Dept., Univ. of Calgary, Calgary, Alta., Canada). 1967. A NEW PLASTIC-BAG WATER SAMPLER. J. Fish. Res. Bd. Canada, 24(11): 2461-2465.

The plastic-bag sampler described was developed in connection with studies of diel cycles and seasonal variations in the populations of the plankton communities of some mountain lakes in Banff and Jasper National Parks. Most of these lakes are 2 km or more from the nearest road.

9735. Miller, Bruce Stuart (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1967. STOMACH CONTENTS OF ADULT STARRY FLOUNDER AND SAND SOLE IN EAST SOUND, ORCAS ISLAND, WASHINGTON. J. Fish. Res. Bd. Canada, 24(12): 2515-2526.

Starry flounder fed mainly on priapulids, nemerteans, polychaetes, and lamellibranchs. Sand sole fed on fish, mysids, shrimp, and squid. Both species appeared to be daytime feeders. Starry flounder ceased feeding during the months of lowest water temperature. This indicates that the local commercial fishery for starry flounder takes fish when they are in poor physical condition. Sand sole showed little reduction in feeding during the cold-water months. The stomach of the starry flounder appeared to be used primarily as a holding organ and was emptied in about 9 hours. The sand sole stomach was used for digestion, which, for forage fish, took longer than 24 hours to complete. (Auth.)

9736. Paulik, G. J., A. S. Hourston, and P. A. Larkin (Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada). 1967. EXPLOITATION OF MULTIPLE STOCKS BY A COMMON FISHERY. J. Fish. Res. Bd. Canada, 24(12): 2527-2537.

A complete analytical solution is presented for the problem of finding the common rate of exploitation that maximizes total sustained yield from a mixture of stocks when each stock follows a Ricker reproduction curve. A computer program is described which solves this problem for up to 20 stocks varying in both reproductive potentials and absolute sizes. Some aspects of the management of Pacific salmon and fishing strategies are discussed in relation to the question of obtaining maximum yields when harvesting mixtures of stocks under various constraints. (Authors)

9737. Berst, A. H., and A. A. Wainio (Ontario Dept. of Lands and Forests, Research Branch, Maple, Ont., Canada). 1967. LAMPREY PARASITISM OF RAINBOW TROUT IN SOUTHERN GEORGIAN BAY. J. Fish. Res. Bd. Canada, 24(12): 2539-2548.

Of 2,614 adult rainbow trout sampled from the Nottawasaga River of Georgian Bay during the period of 1961-67 inclusive, approximately 7.1% had one or more lamprey marks. The trout ranged in fork length from 10 to 33 inches (25 to 84 cm). However, lamprey marks were present only on fish over 16 inches (40 cm) in length. Multiple scarring was found on 30% of the trout that were marked. The incidence of marked fish reached a maximum of 17.2% in the spring of 1962, then declined to 1.3% in the fall of the same year. This decline was coincident with a reduction in the lamprey population after experimental lampricide treatment of the Nottawasaga River and adjacent lamprey spawning streams during 1960 and 1961. The incidence of marked fish remained at a relatively low level for a period of 4 years, then increased substantially, after the presumed recruitment of metamorphosed lampreys during 1966 and 1967. (Authors)

9738. Jonas, R. E. E., and E. Bilinski (Fisheries Research Board of Canada, Vancouver Lab., Vancouver, B. C., Canada). 1967. PHOSPHOLIPASE A ACTIVITY IN RAINBOW TROUT MUSCLE. J. Fish. Res. Bd. Canada, 24(12): 2555-2562.

A sensitive method for assay of phospholipase A activity in the lateral line muscle of rainbow trout is described. ^{14}C labelled lecithin was converted to lysolecithin by the enzyme. Unreacted lecithin was removed by silicic acid column chromatography and the lysolecithin recovered by thin-layer chromatography. The amount of lysolecithin formed was between 43 and 87 mμmoles per gram lateral line muscle per hour under the experimental conditions. The amount formed was directly proportional to time between half an hour and 4 hours and the optimum pH was found to be approximately 7.5. The results are discussed in relation to the enzymic activity previously demonstrated in fish muscle. (Authors)

9739. Patriquin, David G. (Marine Sciences Centre, McGill Univ., Montreal, Quebec, Canada). 1967. BIOLOGY OF Gadus morhua IN OGAC LAKE, A LAND-LOCKED FIORD ON BAFFIN ISLAND. J. Fish. Res. Bd. Canada, 24(12): 2573-2594.

Gadus morhua L. occurs in Ogac Lake, a salt, meromictic lake on Baffin Island that receives influxes of seawater only during the highest summer tides. Cod of the order of 10,000 of lengths 25 cm and greater and 500 of lengths greater than 60 cm were present. The size ranges for various ages far exceeded those of oceanic populations. Feeding conditions were poor, and sea urchins predominated in the diet. Large cod (greater than 50 cm) were highly cannibalistic, and it was estimated that they consume of the order of 3,500 fish of 20-40 cm annually. Maturation occurred at the unusually large size of 85 cm in females, and at about 65 cm in males. Apparently many of the cod never reach these sizes. Spawning was from late May to early July in 1962, and initiation of spawning appeared to be related to light. The hatching of cod larvae coincided with the appearance of the nauplii of the dominant copepod in the lake. Egg size was highly variable and

exhibited a curious bimodalism. Variation in vertebral and fin-ray counts was slight in spite of high environmental variability, and thus appears largely genetically controlled. Possibly the first inhabitants came from Greenland stocks, which have high growth rates similar to the faster growing cod in the lake, and similar high length at maturity. Meristic characters also suggest affinity with Greenland rather than Labrador cod. The hydrography of the area and the possibilities of larval drift or adult migration into the lake are discussed. Cannibalism must exert continuing selection for high growth rates, but very poor feeding conditions and hierarchial dominance effects probably prevent general attainment of high growth rates. (Auth.)

9740. Saunders, Richard L., and K. Radway Allen (Fisheries Research Board of Canada, Biological Station, St. Andrews, N.B., Canada). 1967. EFFECTS OF TAGGING AND OF FIN-CLIPPING ON THE SURVIVAL AND GROWTH OF ATLANTIC SALMON BETWEEN SMOLT AND ADULT STAGES. J. Fish. Res. Bd. Canada, 24(12): 2595-2611.

Rates of recapture of Atlantic salmon marked as naturally produced smolts in the Northwest Miramichi River, New Brunswick, were 2.9 for tagged and 3.9% for fin-clipped grilse and 0.7 for tagged and 1.8% for fin-clipped larger salmon. There are indications that survival to the adult stage is much higher for unmarked smolts than for tagged or fin-clipped fish. Length measurements of 117 tagged, 607 fin-clipped, and 301 unmarked grilse taken above tidehead in the Northwest Miramichi showed that those entering freshwater early in the season were smaller than those entering later. Tagged grilse were shorter than fin-clipped grilse which returned at the same time, and the fin-clipped grilse were shorter than unmarked ones. Rates of increase in size among tagged, fin-clipped, and unmarked grilse during the season of return to freshwater (June through October) did not differ significantly. (Authors)

9741. Raleigh, Robert F. (Bureau of Commercial Fisheries Fish-Passage Research Program, Seattle, Wash.). 1967. GENETIC CONTROL IN THE LAKEWARD MIGRATIONS OF SOCKEYE SALMON (Oncorhynchus nerka) FRY. J. Fish. Res. Bd. Canada, 24(12): 2613-2622.

Eggs of sockeye salmon taken from tributary, outlet, and beach spawners at Karluk, Alaska, were treated identically from time of egg fertilization through time of testing as fry in a laboratory. Test lots were released during the day and at night in a central release pool from which the fry could migrate either upstream or downstream through simulated stream channels. Oxygen-saturated water at 50° F (10° C) was pumped through the 40-ft (12.2-m) gravel-bottomed simulated stream at about 0.3 ft/sec (9.1 cm/sec). Test results showed that directions (upstream or downstream) and times (day or night) of migration differed substantially between fry from the tributary and those from the outlet. Fry from beach spawning reacted in a manner similar to that of the tributary fry. These differences were concluded to be of genetic origin. The possible interaction of innate behavior and environment in controlling the migratory movements of salmonid fry is discussed along with the significance of choosing a donor stock with appropriate innate responses to make best use of a new environment. (Auth.)

9742. Applegate, Vernon C., B.G.H. Johnson, and Manning A. Smith (Bureau of Commercial Fisheries Biological Station, Sandusky, Ohio). 1966. THE RELATION BETWEEN MOLECULAR STRUCTURE AND BIOLOGICAL ACTIVITY AMONG MONONITROPHENOLS CONTAINING HALOGENS. Great Lakes Fishery Comm., Technical Report No. 11. pp. 1-19.

The results of tests of the biological activity of certain nitrophenols containing halogens are reported. Some of these are shown to be significantly more toxic to larvae of the sea lamprey (Petromyzon marinus L.) than to fishes. It is proposed that the death of lamprey larvae exposed to these compounds results from an acute hypotension (shock) with concomitant circulatory and respiratory failure. Rainbow trout (Salmo gairdneri), on the other hand, appear to die, at higher concentrations of the toxin, due to a chemically-caused mechanical interference with respiration

through the gills. A systematic series of studies of mononitrophenols containing halogens disclosed that those phenols having the nitro group in the para-position and a halogen atom or group in the meta-position are generally more toxic to lampreys than to fish. The halogens or halogen groups used in this study were fluorine, chlorine, bromine, and trifluormethyl. The same substituents in other positions only occasionally gave rise to selectively toxic compounds. The relationship between the selectively active class of nitrophenols containing halogens and other related structures is discussed. (Authors)

9743. Starkey, Roland J., and John H. Howell (Ben Venue Laboratories, Inc., Bedford, Ohio). 1966. SUBSTITUTED NITROSALICYLANILIDES: A NEW CLASS OF SELECTIVELY TOXIC SEA LAMPREY LARVICIDES. Great Lakes Fishery Comm., Technical Report No. 11. pp. 21-29.

Structure activity relationships of substituted 3-nitro- and 5-nitro-salicylanilides and related compounds have been evaluated to elucidate their activity as potent selectively toxic sea lamprey larvicides. (Authors)

9744. Huck, Lois Lee, and Gerald E. Gunning (Dept. of Biology, Tulane Univ., New Orleans, La.). 1967. BEHAVIOR OF THE LONGEAR SUNFISH, Lepomis megalotis (Rafinesque). Tulane Stud. Zool., 14(3): 121-131.

Longear sunfish, Lepomis megalotis (Rafinesque) consistently exhibit aggressive behavior when placed in small aquaria in the laboratory. Apparently there is less aggressive behavior in wild populations in their natural Louisiana stream environments. Of the many longear sunfish collected from their natural habitat, few had any fin damage and none had extensive fin damage or body scars. A comparison of field observations with laboratory experiments showed that aggressive behavior in the longear sunfish increases markedly due to laboratory conditions, especially when the fish are confined to smaller areas, or volumes, than they normally occupy in nature. Field experiments and observations are included for year-to-year occupancy of home range, spawning in the home range, reproductive behavior, feeding behavior, and aggressive behavior, as well as laboratory work on aggressive behavior. (Authors)

9745. Bishop, H. D. 1967. ROADSIDE TROUT FISHING.....WHAT'S WRONG WITH IT? Amer. Forests, 73(6): 6-7, 58-59.

Many of the 9 million trout stocked each year by California go into roadside trout streams. Anglers have learned when and where these dumps occur and their bait goes into the water with the fish. "Life in the wild" for many of the stocked trout is a matter of minutes. The description of modern trout management may make some anglers happy that they are, or can still make it, over-the-hill.

9746. Tabor, Richard L. (Northern Illinois Univ., DeKalb, Ill.). 1966. THE EFFECT OF LAKE BLOOM ON THE TOTAL HARDNESS CONTENT OF WASCO LAKE. J. Tenn. Acad. Sci., 41(4): 132-134.

The effect of aquatic bloom on the total hardness content of a small lake was investigated in this study. It was found that total hardness decreased rapidly and, in general, quite uniformly from the date of the first lake bloom. The lowest hardness content was reached at all sites about one month from the onset of bloom. After that date total hardness increased steadily at all sites. A drop in the magnesium content, which was particularly sharp during the initial bloom, was noted. This was attributed to the incorporation of magnesium into the chlorophyll molecules of the bloom. (Auth.)

9747. Schoffman, Robert J. (Griffin High School, Springfield, Ill.). 1967. AGE AND RATE OF GROWTH OF THE CHANNEL CATFISH IN REELFOOT LAKE FOR 1960 AND 1966. J. Tenn. Acad. Sci., 42(1): 12-14.

The study of age and growth of channel catfish in Reelfoot Lake, Tennessee, has extended over a period of fourteen years. The second study (Schoffman 1961) showed a decrease in length and weight. During the last five years of the second

study, there has been no commercial fishing of game fish. Commercial fishing of game fish was abolished in 1955. Since this 1955 act commercial fishermen have increased their efforts to take more rough fish, especially channel catfish. This increased fishing pressure on channel catfish in Reelfoot Lake has not effected their productivity since both length and weight have increased since 1960 (Schoffman 1961). This study also shows more individuals in the older age groups have been taken. (Auth. conclusions)

9748. Hardy, C. J. 1967. THE FECUNDITY OF BROWN TROUT FROM SIX CANTERBURY STREAMS. New Zealand Marine Dept. Fish. Tech. Report No. 22. 14 p.

From a sample of 134 mature female brown trout with a size range of 19.5 cm to 66.5 cm, from six waters in Canterbury a graph has been constructed which shows a curvilinear relationship between the ova number and the fork length of the fish. The slope of the straight line plotted on a log basis with the formula,

$$\text{ova} = 0.659 \text{ length}^{2.072},$$

has a highly significant correlation factor, r = 0.91. The number of ova is thus approximately proportional to the fork length squared. Egg diameters from 33 totally mature females are shown to increase linearly when plotted against length. The formula for the slope of the line was calculated as,

$$\text{ova size (cm)} = 0.3722 + 0.0033 \text{ length.}$$ (Auth. summ.)

9749. Brynildson, Oscar M. 1967. DISPERSAL OF STOCKED TROUT IN FIVE WISCONSIN STREAMS. Wisconsin Conservation Dept. Research Report No. 26. 9 p. 42 graphs.

Brook trout stocked as fingerlings during early summer and during the fall remained near the stocking sites or tended to disperse a short distance above the stocking sites by the following spring. Yearling brook trout released in winter were concentrated 3 to 4 miles above the stocking site the following spring. Yearling brook trout released in March were distributed in a one-mile section below the stocking site within 10 days after release. Brown trout stocked as fingerlings during early summer and during the fall remained near the stocking sites or dispersed upstream from the stocking sites by the following spring. Yearling brown trout released during January were distributed above and below the stocking sites, but were concentrated at the stocking sites the following April. Out of six stocks of yearling brown trout released during March, four had greater dispersal downstream than upstream from the area of release and two had greater dispersal upstream than downstream a week to a month after release. Various strains of rainbow trout stocked as fingerlings during early summer and during the fall remained near the stocking sites the following spring. Yearling fall-hatched rainbow trout released in March were concentrated at the stocking sites and had only limited dispersal upstream and downstream from the stocking sites 3 to 4 weeks after release. (Auth.)

9750. Sinclair, Sol, S. Trachtenberg, and M. L. Beckford (Univ. of Manitoba, Winnipeg, Man., Canada). 1967. PHYSICAL AND ECONOMIC ORGANIZATION OF THE FISHERIES OF THE DISTRICT OF MACKENZIE, NORTHWEST TERRITORIES. Bull. Fish. Res. Bd. Canada, Ottawa, No. 158. 70 p. Map.

This report describes the physical and economic organization of the fisheries in the District of Mackenzie from 1958 to 1964. The 5 chapters cover development of the commercial fishery, fish buyers and fishermen, investments and gross sales, and domestic and sport fisheries. The domestic and sport fisheries contributed to the food supply and to the social and economic development of the area. In the domestic fishery, the needs of those individuals dependent upon fish for human and dog food were not adequately satisfied. Among the more urgent requirements were improvements in methods of fishing, handling, and preservation. Recent years saw a substantial increase in sport fishing activity with consequent benefits in increasing employment and incomes in the Northwest Territories. With generally increasing disposable incomes, leisure, mobility, and accessi-

bility of sites, this trend could continue at an even more accelerated pace. Such developments could create problems such as competition between commercial fishermen and anglers, difficulties in resource management in ensuring maximum sustained stocks of fish, and difficulty in implementing measures to ensure the maximum contribution of sport fishing to the local economy.

9751. Carrothers, P. J. G. (Fisheries Research Board of Canada Biological Station, St. Andrews, N. B., Canada). 1967. AUTOMATIC UNDERWATER PHOTOGRAPHIC EQUIPMENT FOR FISHERIES RESEARCH. Bull. Fish. Res. Bd. Canada, Ottawa, No. 159. 35 p. Appendix.

The Edgerton, Germeshausen and Grier (EG&G) automatic, underwater camera has been adapted to make both benthic and pelagic observations required by biological fisheries research. This adaptation involved minor modifications to the commercial equipment, and design and construction of quite extensive supplementary units, primarily for appropriate positional and functional control of commercial equipment. These include: a protective support cage, a bottom contact function, an underwater control unit, and a surface control unit for benthic observations; a special lightweight, streamlined case for pelagic observations; and a battery charger, specially designed to recharge the camera batteries from some of the more common types of power found on fisheries vessels. Special requirements for fisheries research are stated, pertinent features of the commercial equipment are outlined, and the design and operation of the supplementary units are described. (Auth.)

9752. Cairns, John Jr., Neal R. Foster, and Jules J. Loos (Dept. of Zoology, Univ. of Kansas, Lawrence, Kan.). 1967. EFFECTS OF SUBLETHAL CONCENTRATIONS OF DIELDRIN ON LABORATORY POPULATIONS OF GUPPIES, Poecilia reticulata Peters. Proc. Acad. Nat. Sci. Phila., 119(3): 75-91.

Nine populations of guppies were maintained in five-gallon aquaria under controlled conditions of food, water, temperature, and photoperiod. Three of the populations were selected as controls and of the remaining, two were exposed to a concentration of 0.0018, two to 0.0056, and two to 0.01 ppm dieldrin for a period of fourteen months. These three concentrations are near the estimated "biologically safe concentration" for acute exposure of guppies to dieldrin. During the first two to three months, the exposed populations developed greater total numbers of individuals than did the controls. This phenomenon has been interpreted as an inhibition of the normal predation by the adults upon the fry, a slight change in the feeding behavior of the adults induced by the presence of dieldrin. The difference in the average total monthly number of fish between the exposed and the control populations disappeared after about six months. Toward the end of the experiment, there was suggestive evidence that the long term exposure to dieldrin had had deleterious effects upon reproductive success, at least in the highest concentration tested. (Authors)

9753. Manar, Thomas A. (Bureau of Commercial Fisheries Biological Lab., Honolulu, Hawaii). 1967. PROGRESS IN 1965-66 AT THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY, HONOLULU. U. S. Fish and Wildlife Service Circular 274. 51 p.

This report deals with research results achieved by the Bureau of Commercial Fisheries Biological Laboratory in Honolulu from July 1, 1965 to December 31, 1966. Stressed are the studies which have provided the first numerical estimates of the size of the skipjack tuna population of the central Pacific Ocean, an untapped stock of fishes that could hugely increase the U. S. tuna catch. Investigations with a new, sophisticated sonar and a small two-man submarine are also described. Publications issued or in press during the period are listed.

9754. Sykes, James E. 1967. REPORT OF THE BUREAU OF COMMERCIAL FISHERIES BIOLOGICAL LABORATORY ST. PETERSBURG BEACH, FLORIDA, FISCAL YEAR 1966. U. S. Fish and Wildlife Service Circular 257. 18 p.

This is the third fiscal report of the Bureau of Commercial Fisheries Biological Laboratory, St. Petersburg Beach, Fla. Progress in Estuarine and Red-Tide

Research Programs is described by project. The application of biological information toward the maintenance and conservation of estuarine zones is stressed. The programs are designed to document the relatively unknown scope of biological productivity in the coastal zones of the eastern Gulf of Mexico, to measure the effect of changes in these zones, and to develop methods of increasing marine organisms which can be used by man.

9755. Joyner, T., and R. Eisler (Lab. Radiation Biology, Univ. of Washington, Seattle, Wash.). 1961. RETENTION AND TRANSLOCATION OF RADIOACTIVE ZINC BY SALMON FINGERLINGS. Growth, 25(2): 151-156.

Twenty-five chinook salmon fingerlings were immersed for twenty-four hours in 5 liters of lake water containing 0.2 ppm of zinc labelled with 18.54 microcuries of zinc-65. Periodic assays of the gamma radioactivity in the fish showed that the rapidly growing fish had removed approximately 2 percent of the radioactive zinc from the medium and had retained nearly all of it for 63 days after transfer to flowing lake water. The increase with time in the percent of total body radioactivity contributed by the vertebral column, head, and visceral mass indicates an accumulation of zinc in these parts at the expense of the remainder of the fish. (Authors)

9756. Eisler, R. (Librarian: Univ. of Washington College of Fisheries, Seattle, Wash.). 1961. EFFECTS OF VISIBLE RADIATION ON SALMONOID EMBRYOS AND LARVAE. Growth, 25(4): 281-346.

In a preliminary experiment, embryonic and larval developmental stages of rainbow trout were exposed for 72 hours to 157 foot-candles of fluorescent light characterized by wave length range of 3,663 to about 7,000 Angstrom units with mean energy transmission peak near 5,600A (green-yellow portion of spectrum). Results indicate that embryonic stages irradiated prior to onset of extensive body pigmentation exhibit high mortality and arrested development prior to death; but, groups irradiated after that period are apparently unaffected by light. Results of the first experiment with chinook salmon show that various developmental stages react differently when exposed for 168 hours to 157 ft.-c. of the previously described light source. In general, embryos subjected to artificial light before formation of retinal pigments display high mortality at all stages of growth, retarded development at death, accelerated hatch, reduced fingerling growth, and severe liver damage. Groups irradiated during the remainder of embryonic development, including the period encompassing hatching processes, are less susceptible to visible rays but still exhibit increased mortality, reduced growth, or both. Exposure of larvae to fluorescent light produced no measurable changes by the end of the 197 day experiment. Large variations were evident among progeny of different brood lots regarding most experimental criteria. For the final portion of the study, four embryonic stages of chinook salmon were exposed to different intensities of the experimental light source for a continuous period of 120 hours. Zygotes subjected to radiation at the beginning of the 64 cell stage of development were especially affected and exhibited measurable graded responses to graded intensities of light; thus, comparatively high intensities (i.e., 150 or 90 ft.-c) produced arrested development at time of death, high premature hatching mortality, accelerated hatch, increased embryonic and larval mortality, reduced fingerling growth in length and weight, decrease in mean number of anal fin rays and parr marks of resultant fingerlings, and increase in mean vertebrae number. Embryos exposed to light of high intensity between age 8 and 13 days, when compared to controls, displayed high mortality which was especially severe immediately prior to hatching, reduced fingerling growth, a large number of spinally-deformed fingerlings, and a decrease in mean number of anal fin rays. Groups exposed to an intensity of 37 ft.-c. during age 8 to 13 days produced fingerlings with fewer vertebrae and dorsal fin rays than embryos reared in near-darkness of 0.02 ft.-c. or exposed to bright light. Embryos illuminated between blastopore closure and pigmentation of the optic vesicles (age 15 to 20 days) were relatively unaffected at day 200 when compared to groups irradiated prior to closing of the blastopore; however, light-exposed embryos, when compared to controls, had reduced hatch,

accelerated fingerling growth, and reduction in mean number of anal fin rays of surviving fingerlings. Embryos exposed to 37 ft.-c. during age 15 to 20 days produced fingerlings with fewer dorsal fin rays than embryos reared in near-darkness or exposed to bright illumination. Groups irradiated after formation of retinal pigments (days 22 to 27) were apparently not affected by hatching time; but, information is lacking on these groups after hatching. As was true in the previous experiment, pronounced differences were evident among progeny of different parents in practically every respect. The processes by which visible radiation modifies various physiological systems of the salmon may be attributed to thermal, photochemical, and photoelectric properties of the experimental light source. (Auth.)

9757. Pandian, T.J. (Zoological Laboratory, Univ. of Madras, Madras, India). 1967. INTAKE, DIGESTION, ABSORPTION AND CONVERSION OF FOOD IN THE FISHES Megalops cyprinoides AND Ophiocephalus striatus. Marine Biol. 1(1): 16-32.

Different criteria for the assessment of conversion efficiencies of fishes are briefly reviewed, and some important terms defined. In the eurysaline fishes Megalops cyprinoides and Ophiocephalus striatus, transformation of food has been studied as a function of body weight, using both protein and energy transfer criteria. The duration of the 28 experiments conducted varied from 15 to 30 days. Rates of food intake, digestion, absorption and conversion decrease with increasing body weight. Absorption efficiencies are about 97% for the protein fraction, and 91% for the total food consumed; they do not vary appreciably among the individuals of different body weights. Conversion efficiencies of the protein fraction and the total food consumed decrease from about 40% in 2 g individuals to about 15% in 150 g ones. In general, the relations show curvilinear trends, but in weight between 10 and 150 g, straight lines are obtained. The slopes of these lines differ in the two species tested. Such differences are related to the physiological state of the fishes and their growth potential. The inverse relation between body weight on the one hand, and food intake, absorption and conversion on the other, are attributed to aging. It is suggested that age affects these intermediate steps via the enzyme-complex of the digestive system. The b values obtained for the relation between body weight on the one hand, and metabolism, food intake and absorption on the other, do not correspond to the surface or weight proportion rule, but to an intermediary type of neither surface nor weight proportionality. As the values obtained are similar, it is concluded that there exists a direct and proportionate relation between metabolism, food intake and absorption. The respective values for the relation between body weight and conversion rate are low indicating that there is a direct, but nonproportionate relation between growth and metabolism. (Auth.)

9758. Ankorion, J., Rom Moav, and G. Wohlfarth (Dept. of Genetics, The Hebrew Univ., Jerusalem). 1967. A "MODIFIED GERBER METHOD" FOR RAPID DETERMINATION OF FAT CONTENTS IN FISH. Bamidgeh (19(2/3): 46-49.

9759. Duck, Harvey. 1967. SALMON SPAWN NEW HOPE FOR GREAT LAKES FISHING. National Wildlife, 5(3): 18-19.

The stocking of salmon fingerlings into the Great Lakes may have begun the greatest comeback in the history of fisheries management.

9760. Erdman, Donald S. 1967. INLAND GAME FISHES OF PUERTO RICO. Commonwealth of Puerto Rico Dept. of Agriculture, San Juan, P.R. Illus.

9761. Roberts, Travis. 1967. ANNUAL REPORT FOR 1966 COOPERATIVE FISHERY UNITS. Bureau of Sport Fisheries and Wildlife Resource Publication 41. 80 p.

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